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STUDENTS' PERCEPTION OF THEIR TEACHER EDUCATION PHYSICS CURRICULUM IN TANZANIA

by

VICTORIA JOSHUA KESSI

A THESIS

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submitted by Victoria Joshua Kessi in partial fulfilment of the requirements for the degree of Master of Education.

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Supervisor

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.....

Date ....Sept. 25, 1985.....

This thesis is dedicated to my mother, Aikaeli Matilya, and my father, Joshua Kessi, for their lifetime love and care

ABSTRACT

The study attempted to reveal students' perceptions of their physics curriculum in Tanzania. Ninety students (89 male, 1 female) in their final year of a teacher preparation program participated in the study.

Two conceptual approaches were adopted—empirical analytic and situational interpretive. Data consisting of students' views and opinions about the curriculum were collected by means of semi-structured interviews and a questionnaire. The researcher constructed the questionnaire survey on the course content, pedagogical skills, teaching practice, resources, and personal interests. A sample of 13 students (out of 90) was systematically selected for interviews. Interviews lasted approximately 45 minutes and were audio-recorded, transcribed, interpreted, and then validated by the interviewees. Field notes, classroom observations, and still photographs were compiled to help in understanding some classroom situations. Numerical data from the questionnaire were analyzed to determine frequences and percentage distributions on the rating scales; and responses to open-ended questions were analyzed to identify categories. Interview data were analyzed to identify themes.

Findings indicate that students understand the curriculum to be that which is translated and interpreted in their classes perceiving it to be theoretical and emphasizing knowledge of content. The curriculum is perceived to be relevant and strong in providing skills required for lesson preparation, lesson presentation and classroom management. However, the curriculum is perceived to be lacking in providing a "hands on" experience, knowledge and skills in various methods of teaching, and an informed teaching practice supervision. A heavy reliance on final examinations and lack of sufficient material and human resources is also perceived to be a major weakness.

The findings suggest that a curriculum may have various meanings for various participants and that effort to develop and evaluate it should take into consideration such variations. The findings also document the importance of considering context in an attempt to understand participants' interpretations of a curriculum.

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CHAPTER I

BACKGROUND AND OVERVIEW OF THE STUDY

Introduction

The training of secondary school teachers in Tanzania is carried out in two separate institutions: the University of Dar-es-Salaam and Teachers' Colleges. The University offers a three and a half year program. Students in this program are prepared to teach at all levels of secondary schools--forms 1 to 6. The diploma program, which is the subject of this study, runs for two to three years in Teachers' Colleges. It prepares teachers for secondary schools--forms 1 to 4. A detailed description of the diploma program is provided in Chapter II.

The study will focus attention on the physics component of the teacher education program (diploma), which shall be referred to as the "physics curriculum." The existing physics curriculum was developed and mandated in 1980 as a move toward the improvement of previously existing science and mathematics curricula in teachers' colleges. This was a response to a nation-wide resolution passed in 1978 by the Ministry of National Education to consolidate science education at all levels of education in Tanzania (The United Republic of Tanzania, 1978).

The participants in the study will be students who are in the process of becoming science teachers and their instructors. Throughout this thesis, 'students' will be used to refer to the student teachers in the program and 'teachers' will be used to refer to their instructors, unless otherwise stated.

Rationale

Since the inception of the physics curriculum in 1980, more than 200 physics teachers have graduated from college and every year the program continues to grow. To date, no formal study has been conducted to evaluate or to understand the impact of the physics curriculum. Meanwhile, assessments of student achievement through examinations continue to be used as the criteria for judging the success of the program.

While assessment procedures have reported considerable successes, numerous criticisms have been directed toward the physics curriculum, some of which have to do with the content and its organization, and some with the process of implementation. It has been mentioned frequently in a number of subject area meetings and examination reports that physics teachers graduating from the program lack interest and competence in teaching physics (Institute of Education, 1983). In several teaching practice reports (Dar-es-Salaam Teachers' College, 1982; Kleruu Teachers' College, 1982), it has been indicated that a number of student teachers in

their final year fail to develop some very basic physics concepts in the classes that they teach, and that they teach without motivating their students.

At a science teacher-educators' workshop held in Moshi, Tanzania, in January of 1983, widely divergent views about lack of motivation, interest and concern on the part of students in the physics and other science courses were expressed by the participants (Institute of Education, 1983). Although there was widespread agreement as to the observed creativity in the construction of physics teaching aids, there was no consensus as to the students' command of the subject matter in general. It was argued that students were not paying enough attention to the learning of physics concepts.

Students, on the other hand, also expressed complaints about the physics curriculum. Among their many concerns, the issue of relevance seemed to be dominant; they have continuously questioned the relevance of some topics year after year. On a number of occasions, students have expressed the feeling that the emphasis put on academic topics and on the final national examination is inappropriate and that teaching competence should be the main criteria for judging their success (Dar-es-Salaam Teachers' College, April, 1982).

Judging by the degree of divergence and lack of consensus in the way the program is judged and assessed by the parties involved, one senses a painful dissonance in the

participants' perceptions of the curriculum. However, conflicting perceptions regarding a curriculum are neither uncommon nor necessarily unhealthy. Nevertheless, the way that these conflicts manifest themselves in this case do suggest a serious problem constituted by a lack of understanding of one another's perceptions. Participating groups do not seem to understand the meanings and interpretations that each of them attach to the curriculum. When lack of understanding of this nature is left unattended, it is likely to frustrate the efforts of all those concerned. Effective communication and effective implementation are hindered.

Purpose of the Study

This study was initiated to explore and uncover students' perceptions of the physics curriculum as planned and as implemented in the teacher preparation classes.

Statement of the Problem

The specific problem addressed in this study concerns the students' perceptions of the physics curriculum in terms of its meaning and constitution, its relevance, its strengths and its weaknesses. Answers were sought to the following questions:

1. What meanings does the curriculum have for the students?
2. From the students' point of view, what constitutes the

curriculum?

3. Do the students find the curriculum relevant to their preparation to become physics teachers?
4. What do the students perceive as the strengths and weaknesses of the curriculum?
5. What suggestions do students have (if any) for alleviating perceived problems of the curriculum?

Significance of the Study

The study sought to reveal various meanings of the physics curriculum which might not have previously been recognized. The knowledge of students' perceptions of the physics curriculum will be helpful in increasing understanding for various groups of people involved in the program--from the students themselves, teachers, administrators, evaluators, curriculum developers, and decision makers.

1. To teachers, the findings may provide them with a better understanding of their students, their concerns, and the context in which learning occurs. Such an understanding may lead to a reduction of dissonance between teachers' perceptions and those of their students, leading to more effective classroom communication and effective implementation of the curriculum.
2. To decision makers and curriculum developers, the findings may provide a valuable data base for future decisions concerning the revisions/changes of the curriculum.
3. To students, the findings may motivate them into

examining and reflecting on their own perceptions to understand themselves and the curriculum better.

4. To evaluators, findings may provide them with a better understanding of students' concerns and the perceived strengths and weaknesses of their evaluation procedures. Such an understanding may lead to more meaningful and effective evaluation procedures.
5. To researchers, findings from this study may provide some new directions for future research.

In general, therefore, understanding the physics curriculum as perceived by the students may engage all those concerned in what Maxine Greene (1978, p. 108) calls "the process of demystification." They will work together to eradicate the constraints experienced in implementing the curriculum.

> There is practically no one who makes decisions about the lives of others who could not benefit from a better understanding of the others' point of view. (Barrit, Beekman, Bleeker and Mulderij, 1983, p. 82)

Assumptions, Delimitations, and Limitations

Assumptions

The following assumptions were central to this study:

1. That students' perceptions, both casual and deeply-held personal opinions, were disclosed through the process of interviews and their responses to the questionnaire;

2. That questions asked on the questionnaire and during interviews were intelligible, meaningful, and that they were interpreted accurately by those who responded to them;
3. That students were willing and able to converse in a way that revealed their perceptions and that they reflected some fairly stable perceptions over a period of time;
4. That the interpretations of the questionnaire responses and interviews reflected valid meanings that such responses had for the students.

Delimitations

The population was delimited to students in their final year of the teacher education program on the ground that these students had covered the curriculum quite extensively both in study and in teaching practice.

Limitations

A major limitation resides in the nature of the study itself; since findings may be somewhat situational specific, generalizations in the traditional sense will have to be made with caution. The study attempted, instead, to generalize its findings in a "naturalistic" sense (Denton, 1974; Stephen, 1982). According to these authors, naturalistic generalization is referred to as the recognition of salient characteristics in a particular entity and the interpretations of these characteristics in terms of

defensible and consistent instances of more general categories of social discourse. In order to achieve this kind of generalizability, the researcher hoped to uncover students' perceptions that would make sense to her readers in relation to their own situations and experiences.

Definitions of Terms

Curriculum. The term curriculum refers to a particular course of study, often in a special field, or all courses of study offered by an educational institution. In this study, the term will be used to refer to the physics course of study only.

Program. For the purpose of this study, this term will be used to refer to all courses of study/experiences and their arrangement as planned for the training of secondary school teachers--diploma level--in Tanzania.

Perspective. A perspective is a blend of beliefs, values, motives, expectations and behaviors upon which individuals' perceived situations determine their alternative actions and judge the worth of their anticipated interactions.

Context. The term context will be used to include interests, values and beliefs of participants and also the situational factors (social, economic and political) which may give a program of studies its particular meaning and relevance (Werner and Rothe, 1979, p. 5).

Organization of the Thesis

This chapter has presented a general background and an overview of the study. Chapter II provides a brief description of the Teacher Education diploma program in Tanzania in terms of its physical setting and activities. Relevant literature is reviewed in Chapter III. In Chapter IV, the research design and the methodology employed in collecting and analyzing data are described. Findings from the questionnaire are presented in Chapter V and those from the interviews in Chapter VI. Chapter VII summarizes the study findings by focusing them to the research questions, and then concludes with a brief discussion of the implications arising from the study.

CHAPTER II

THE STRUCTURE AND THE SETTING OF THE PROGRAM

In this chapter a brief account of the significant aspects of the program for the training of diploma-level secondary school teachers in Tanzania is provided. Aspects such as the physical setting, program activities, resources, participants and the courses studied are included. This background is important in that it will enable the reader to put the purposes and findings of this study into meaningful perspective..

Nature of the Program

There are basically three approaches used in the training of diploma level teachers in Tanzania.

1. The In-service Approach (2 yrs): In this approach, students enter college after serving as grade A level teachers for at least three years. (Grade A level teachers are certificate teachers who have had four years of secondary education, or its equivalent, plus two years of teacher training. The grade A level teachers are trained to teach all levels of primary school.) They spend two years in college to study general education courses and specialize in the teaching of two secondary

school subjects.

2. The 'Ordinary' Pre-service Approach (2 yrs): For this approach, students enter college after six years of secondary school, or its equivalent. They then spend two years in college to study general education courses and specialize in the teaching of two secondary school subjects.
3. The 'High School' Pre-service Approach (3 yrs): For this approach, students enter college directly after four years of secondary school. The program takes three years and students study for their high school certificate as well as specialize in the teaching of two secondary school subjects. The outlines of education courses and teaching subject courses covered in this approach are exactly the same as the ones outlined for the other two approaches.

This study focused attention on finalist students in the ordinary pre-service and the high school pre-service programs. Students in the in-service program were left out as it happened that none of these students were specializing in the teaching of physics.

Physical Setting

There are six Teachers' Colleges in mainland Tanzania that carry out the training of diploma level secondary school teachers. Along with the diploma programs,

these colleges also conduct programs for both pre-service and in-service primary school teachers. Different colleges offer different programs and different subject combinations, as presented in Table 1.

Program Activities

Students and Teachers

Each student in the diploma program, irrespective of the approach followed, has to specialize in the teaching of two subjects which have to be chosen within a particular subject area combination, as shown in Table 1. A student who chooses a science and mathematics combination, for example, has to study any two of the subjects offered in this combination (i.e. mathematics, physics, chemistry, biology and geography). In conjunction with the two teaching subjects, courses in principles of education, political education, physical education and one on 'cultural studies' (i.e. music, fine art and drama) are required.

Integrated with the classroom studies are out-of-class activities primarily aimed at either generating money or providing services for the college community. What is advocated in these work activities/experiences is the concept of self-reliance, where students learn by doing and at the same time contribute to their own upkeep by using the products of their work (Mmari, 1979). The variety of work activities found in a college is determined by the

Table 1

Colleges Classified by Type of Program and Subject-Area Combination

Name of College	Type of Program Approach	Subject Area Combination
Dar-es-Salaam	Ordinary Pre-service In-service	Science & Mathematics; Languages; Social Studies; Commercial Studies; Home Economics; Nursing; Technical Studies
Kleruu	Ordinary Pre-service	Science & Mathematics
Korogwe	High School Pre-Service	Languages
Marangu	In-service	Languages
Mkwawa	High School Pre-service	Science & Mathematics
Monduli	High School Pre-service	Agriculture

cultural/physical setting of the college and the college personnel available to guide such activities. Some of the work activities include: farming/gardening; care of livestock; poultry; carpentry; simple crafts; fishing; needlework; cleaning the college compound; and conducting adult education classes.

The ordinary pre-service program offers two sessions of six weeks each of supervised teaching practice and 48 weeks of college instruction. On the other hand, the high school pre-service program offers only one session of six weeks of supervised teaching practice and about 74 weeks of college instruction. The minimum number of contact hours allocated to each course and activity in a week is shown in Table 2.

Other Related Activities

Other activities related to the program include curriculum development, supervision of program implementation, and the assessment of student achievement. All the curricula used in the program are developed by the Tanzania Institute of Education in collaboration with teachers of the program and other educators. Supervision of the implementation of the program is carried out by the Ministry of Education through trained school inspectors. Basically, the inspection is carried out to monitor program implementation for purposes of accountability, and assistance in overcoming some problems encountered. Assessment of student

Table 2

Time Allocated to Each Course in a Week

Name of Course	Time per Week Hours
Principles of Education	6½
Political Education	2½
Teaching Subject 1	6½
Teaching Subject 2	6½
Self-reliance/Work Activities	6½
Physical Education	1½
Development Studies	3

achievement is partly carried out by the teachers of the program who grade students' performance in classroom work, judge their teaching competence during teaching practice, and assess their general conduct. The Tanzania National Examination Council measures students' outcomes at the end of the program through standardized achievement examinations. It is this council that gives the final overall grade and issues certificates of diploma in teacher education to successful students.

Teachers

Many of the tutors for the teacher education program are graduates of the University of Dar-es-Salaam or other universities outside Tanzania. In addition, many of them have had secondary school teaching experience of at least three years.

The Physics Curriculum

The existing physics curriculum is designed for students preparing to teach physics in forms 1 to 4 of Tanzanian secondary schools. The curriculum is divided into two major parts; part one deals with principles and methods of teaching physics, and part two deals with general physics knowledge and skills. Among the activities emphasized in the curriculum guide are: lectures and discussions on major physics concepts, experimentation,

construction of physics teaching aids, micro-teachin and field trips and excursions to places of scientific interest. An outline of the physics curriculum guide is provided in Appendix A.

Resources

There are three teachers' colleges that offer the science and mathematics subject combination which includes the physics course. The three colleges, which were all involved in this study, are Dar-es-Salaam, Kleruu and Mkwawa. Several surveys on college equipment supplies have indicated that these colleges, particularly Dar-es-Salaam and Kleruu, have a shortage of science equipment and textbooks (Wizara ya Elimu ya Taifa, 1980). However, it was indicated in these surveys that the science laboratories in these colleges were in good physical condition.

Of late, there has been an additional problem of lack of qualified teachers which has been heightened by an exodus into industries which provide good job opportunities for graduates of science related subjects.

CHAPTER III

REVIEW OF THE LITERATURE

In this chapter, a brief review of the literature related to the present study is presented in four sections. The introductory section defines perceptions and outlines how students' perceptions of educational programs affect the achievement in such programs. In the second section, a survey of several studies on students' and teachers' perceptions of some teacher education programs is presented. The third section presents a critical review of various methodologies and approaches employed in evaluation studies. The fourth section is a summary and conclusion of the review.

Introduction

Perception, like many other constructs in education, is not directly observable. An attempt to define it operationally so as to come out with specific indicators which may be directly measured is difficult.

Nevin (1973) defines perceptions as mental images which partly originate from a person's beliefs, intents and motives which have been passed to him/her as a historical accumulation of interpreted experiences by teachers, parents, and significant others. Perceptions depend in

part upon one's needs, expectations and values and they are developed and modified through learning and maturation (Morgan, King and Robinson, 1979; Hilgard, Atkinson, and Atkinson, 1979; Whittaker, 1976).

Also important is the idea that there exists a relationship between people's perceptions and their behavior, and that when individuals are placed together in a group, their perceptions tend to converge to group perceptions (Penfield, 1958; Nevin, 1973). People tend to perceive what they have learned to perceive, and act on what they perceive (Whittaker, 1976).

Gathering support from this explanation, there is no doubt that perceptions do affect the way that educational programs are developed, interpreted, and implemented. For one thing, program developers inevitably include in such programs that which they perceive as valuable, relevant, and appropriate for students' needs (Macdonald, 1975). Teachers and students, on the other hand, implement such programs according to their interpretations and meanings of the program, which are again based on their personal perceptions.

Students' perceptions are major determinants of the success or failure of a program. While it is teachers who in many cases construct classroom interactions, "it is almost certainly students' perceptions of these teaching environments which are more important" (Jones, 1981, p. 349). In his paper on "promoting students' effectiveness," Munro (1981) stated that students' perceptions of classroom

realities are for the students "true" descriptors of events upon which they are prepared to act. It is students' observations and interpretations which set the context of student learning.

According to Jones (1981), different disciplines tend to generate their own distinctive environment for students and different institutions generate their own "climate." These different environments and climates arise out of students' perceptions of what educational settings are and ought to be like.

Institutional climates, for example, can be determined by the intellectual and social context, particularly the relationship among teachers and students:

> Teachers who are bright, competent, excited by the subject matter, and sensitive to the needs of the students, are the ones who can work miracles even in the absence of ideal conditions for teaching. Correspondingly, teachers who are uncomfortable with their own background knowledge or who are demoralized because of their working conditions can negatively influence students' attitudes towards science. (Science Council of Canada, 1984, p. 19)

Institutional climates are also determined by the physical context like the availability of concrete facilities and equipment, as well as political context such as the degree of public support. All these various contexts influence both what is done and what can be done in implementing an educational program.

Review of Related Studies

Many research and evaluation studies conducted on students' and teachers' perceptions of educational programs have focused on school programs. However, several studies have also looked at teacher education programs in general and teacher education-science programs in particular (Newton & Watson, 1967; Jacknicke, 1978; Ratsoy, McEwen & Caldwell, 1979; Skilton, 1979; Kass, Nay & Jacknicke, 1980; Elder, 1982). Findings from some of these studies have indicated to varying degrees outstanding differences between student teachers' perceptions of their educational programs and the perceptions of their instructors/professors. Student teachers, for example, perceived their teacher education program as impersonal and fragmented with no integration between theory and practice, a view not held by their professors (Ratsoy, McEwen & Caldwell, 1979). Similarly, student teachers perceived their science program as inappropriate in that it placed emphasis on knowledge of content, command of pedagogical techniques, and teaching skills rather than affective and personal qualities such as zest for science, love of children and commitment to teaching. Their professors, on the contrary, perceived knowledge of content and pedagogical techniques to be of utmost importance and felt that emphasis should be placed on these areas (Newton & Watson, 1967).

Elder (1982) attempted to discover, through the perceptions of beginning teachers, the types of approaches to

the learning process (i.e. cognitive, affective or confluent) in their teacher education program at the University of Alberta. Responses to perception tests and need-assessment tests which were administered indicated that teachers found the program to have been cognitive in its approach with little or no attention to affective education. Teachers also expressed some concerns about fragmentation of theory and practice in the program.

Some other studies focused attention primarily upon "practice teaching." In a study to evaluate the practicum component of the Secondary Education's Biological Science Integrated Program (BSIP) at the University of Alberta, Jacknicke (1978, p. 33) reported that:

> . . . the majority of cooperating teachers rated the students' knowledge of science content, knowledge of methodology, interpersonal skills, knowledge of learning theory, and knowledge of the philosophy of science and science teaching as adequate to excellent.

However, the cooperating teachers rated the students' preparation more negatively in the areas of instructional skills, knowledge of school organization and procedures, and classroom management. Similar findings were reported in another study on the perceived adequacy of the practicum component of the Secondary Science Integrated Program (SSIP) conducted at the same university (Kass, Nay & Jacknicke, 1980).

In 1979, Skilton reported a study which was conducted to evaluate the policies of practice teaching of teacher education programs in Queensland, Australia. Among

other findings, the programs were perceived to have provided inadequate preparation for the teaching practice and that supervising teachers were also inadequately prepared for the task. Students also perceived the practice teaching sessions to have been very short and that there were conflicting sets of expectations placed on them by the schools and teacher education institutions.

Studies in Developing Countries

While some problems facing teacher education may be universal, there appear to be some distinctive problems which are of particular significance to developing countries. Marr (1973) conducted a study to examine the actual functioning of a teacher education program in three colleges affiliated to the University of Punjab. His main purpose was to find problems that were being faced and thereafter determine the scope of improvement. From the results of the investigation, student teachers as well as faculty members indicated several major problems, namely: lengthy, theoretical program; inadequate, practical experience; lack of adequate and informed supervision; lack of effort to inculcate teaching skills; inappropriate teaching methods employed by college instructors; and, lack of suitable reading and other support materials. It was also pointed out that the process of evaluation was a chronic problem in that external exams carried excessive weight (50%), and that questions given encouraged rote learning.

A study of similar nature was conducted by Haque (1977) in Bangladesh. The purpose of the study was to examine relevance of curricula offerings to the country's needs and to identify strengths and weaknesses for purposes of improvement. Findings from questionnaire surveys of faculty and graduates of the teacher education program indicated that curricular content and physical facilities were inadequate to produce effective teachers. It was also indicated that the objectives of the curricula were not consistent with the country's developmental needs.

In 1981, Bethel conducted an evaluation study of teacher education programs in the Bahamas in order to determine the extent to which the programs were perceived as being effective, and to discover specific areas of strength and weaknesses. Data were sought from a group of teachers who had graduated from the programs as well as from supervisors of the teachers. The teachers viewed the programs to have been very strong in providing them with skills required to prepare and present lessons. The content of the program included an adequate range of teaching methods. Teachers also identified the methods courses and teaching practice to have been the most valuable aspects of their program. Weaknesses were perceived in the preparation provided in topic areas of classroom management and human relations. The presentation of the programs were also perceived to have been too heavily based on lectures at the expense of demonstration teaching. As in the other two studies,

physical facilities and resources were perceived to have been inadequate.

One recurring shortcoming in establishing students' and teachers' perceptions of educational programs in many of the studies discussed has been the almost total reliance on test instruments and highly structured questionnaires for collecting data. These instruments, although useful in providing a wide range of data base from a large population, are limited in several highly significant ways. In the first place, they predetermine the kinds of data to be collected by identifying areas on which questions are posed. Secondly, they limit the respondents who may have opinions outside the domain of items included in such instruments, as well as preventing respondents from expressing their views more specifically than the scaled responses may allow. Thirdly, and perhaps more significant, information provided is detached from the context and, as such, may be interpreted contrary to the context.

Curriculum Evaluation Methodologies

Evaluation Models

Evaluation studies have done very little as far as uncovering participants' perceptions of educational programs and understanding the contextual situations of such programs. For one thing, most evaluation studies make use of "models" which are neither geared toward studying programs in context, nor suited for such ends. Evaluation models are frameworks

or guidelines within which evaluation activities are conducted (Welch, 1974). Various models have resulted from assumptions and conceptions of educational programs and evaluation in general. Many of the models, for example, have originated from the educational measurement movement, from the growth of 'scientific' research in education, and from pressures of educational accountability (Madaus, Scriven & Stufflebeam, 1983).

Examples of some evaluation models include the "pretest/posttest" model often referred to as "Ralph Tyler's" model. This model resulted from a conceptualization of curriculum as a set of planned school experiences designed to help students achieve behavioral outcomes (Parlett, 1972; Stake, 1975). Evaluation then meant assessing the extent to which curriculum objectives were being achieved by measuring behaviorally defined objectives. Alternately, the CIPP model advanced by Stufflebeam et al. (1971) is designed to discover what can be learned in general about curriculum in terms of context, input, process and product of the package. The "discrepancy" model (Welch, 1974) compares performance with intents and strives to reduce discrepancy. The "Stake Countenance" model (Stake, 1967) is designed to describe the functioning of an educational program and then provide judgements of worth.

It appears that these evaluation models are concerned with behavioral objectives, testing and measurement, and experimentation. Data gathering activities are

therefore largely selected from the field of measurement (Welch, 1974).

Shortcomings and Alternative Approaches

With regard to the inappropriateness of evaluation models which are objective based, Kliebard (1970, cited in Munby, Orpwood & Russel, 1980, p. 101), argues that:

> . . . the simplistic notion that evaluation is a process of matching objectives with outcomes leaves much to be desired. It ignores what may be the more significant latent outcomes in favour of manifest and anticipated ones, and it minimizes the vital relationship between ends and means.

This approach to evaluation assumes that the teacher interprets the curriculum as intended and succeeds in translating it into instructional reality. Whereas such an evaluation approach may furnish evidence on adequacy of instructional plan, it cannot furnish evidence on the validity of the curriculum selection.

The models that are based on testing and measurement have one main advantage, in that they are efficient in producing information on students' performance in many areas of the school curriculum in a short period of time. However, testing measures students' performance without giving any information about the process or the worth of a program. Tests are designed to measure only limited aspects of curriculum which lend themselves to measurement. This limits the "size and number of slices of reality" of the curriculum that can be studied (Larkins, 1973, cited in

Drysdale, 1983).

The experimental approach to evaluation, on the other hand, has been particularly attractive because of its scientific origin and strong endorsement by psychology (Welch, 1983). Strategies in this approach make use of experimental designs with various manipulations, tests and other measures, statistical tests to analyse data, and test significances. This approach regards eduation as an applied science, and presupposes that an experimentally controlled domain of objects and events can be clearly demarcated. However, because education is a very complex phenomenon, it is difficult to control many of its inter-related variables which may contribute to an observed out-come. Many educators have questioned the appropriateness of this approach (Stake, 1975; Patton, 1975; Parlett & Hamilton, 1972; Apple, 1974; Eisner, 1979; Welch, 1983). Parlett and Hamilton, for example, accused the experimen-talists of assuming that educational programs differed little from agricultural "treatments" and could be evaluated in the same fashion. Arguing that evaluation be more con-cerned with description and interpretation than measurement and prediction, they proposed a socio-anthropological approach which they called "illuminative" evaluation, which is based on in-depth understanding of how curricula operate in specific situations.

Similarly, Stake (1975) criticized the evaluation models for their failure to yield a full description and a

view of the merit and the shortcomings of the program being evaluated. Such models, he concluded, ignore pervasive questions that should be raised whenever educational programs are evaluated. As an alternative, he suggested the "responsive" evaluation approach which orients more directly to program activities than to program intents, and emphasizes "the settings where learning occurs, teaching transactions, judgement data, holistic reporting, and giving assistance to educators"(p. 75). Responsive evaluation does not rule out testing and measuring, but these techniques are not seen as essential.

Eisner (1979), like other evaluators who have shown dissatisfaction with evaluation models, argued that evaluation, being a means of knowing, should employ other forms of knowing rather than relying entirely on an empirical form. Stressing that some forms of knowledge about processes of schooling do not lend themselves to transformation into some symbol systems, Eisner proposed an artistic approach to evaluation based on two concepts which he refers to as "educational connoisseurship" and "educational criticism." He describes educational connoisseurship as the art of appreciation which can be used in explaining the character and quality of teaching, the interactions of children, organization of schools, and the use of materials in instruction. He also defines educational criticism as "the re-education of the perception of the work of art" and states that it can be used to illuminate, to enable others to

experience what they might otherwise have missed "by describing classroom events artistically, interpreting such events, appraising such events in a way that will provide constructive feedback to the teacher" (p. 10).

Common to the approaches suggested by Parlett and Hamilton (1972), Stake (1975) and Eisner (1978) is the emphasis on a socio-anthropological approach which orients more directly to program activities in the setting in which learning occurs. Recently, a socio-anthropological approach has become fairly prominent in educational research and evaluation (Stake, 1978; Eisner, 1979; Duigman, 1981; Roberts, 1982; Rist, 1982; Smith, 1981). This approach was a major component of Stake and Easley's (1978) National Study of Science in America, the Canadian Science Education Study (Science Council of Canada, 1984), and the Australian Junior High School Science Education Study (Frazer, 1978). In somewhat similar ways, these studies attempted to understand school science programs in terms of complex patterns of social interactions within school contexts. This was achieved by conducting case studies in some selected schools, whereby data were collected in "natural settings." Findings were presented as narrative descriptions of school and classroom events, portraying, for example, encounters between teachers and students and materials, or reporting conversations and interviews with participants about actions that took place. Although the results were less generalizable in the "experimental"

sense, they appeared to provide a more holistic, sensitive and comprehensive picture of actual happenings in science classrooms.

More recently, there has been an increase in literature on curriculum evaluation being conceptualized as a "sense-making" or an "interpretive" activity (Aoki, 1979; Rothe, 1978; Wilson, 1978; Werner, 1983) and the concept that different kinds of sense can be made of a program depending on the perspective of the evaluator. While criticizing contemporary evaluation as being limited to only one perspective, they have suggested some approaches that aim at contextual understanding of educational programs, approaches that question the underlying foundations/ assumptions of educational programs.

Werner (1983), for example, has described contemporary evaluation procedures as "ends-means" activities which only analyse and judge the methods used in program implementation and how well these methods help educators achieve specific goals. Werner goes on to say that this ends-means perspective can limit evaluators from seeing other important aspects of a program which have to do with the real life or social situations of such programs--the viewpoints and interpretations of teachers and students, and the foundation of a program, i.e. values, assumptions and worth of its goals.

In retrospect, Werner suggests a more encompassing model for program evaluation. In this model he added two

other perspectives to the ends-means perspective: one which he calls "situational interpretive" attempts to uncover meanings and relevance which a program has for those involved; the other perspective he calls "critical interpretive" and it attempts to make explicit the foundations underlying a program.

A few curriculum evaluation studies have employed the situational-interpretative/critical-interpretative approaches. A study conducted to evaluate the British Columbia Social Studies Program, for example, utilized the two approaches, as well as the ends-means, and came up with a "holistic" picture of the program (Aoki, 1979). Of great interest to the present study are the studies done by Drysdale (1983), Benson (1984) and Nadeau (1984).

Drysdale, for instance, in an attempt to understand teachers' and students' interpretations of a biology unit on "Winter Ecology," used in-depth interviews. He came to the conclusion that, although the unit could be taught in class without laboratory activities, the impact of "hands on" experience gave the unit its significance and helped participants to develop a more positive attitude to their winter environment. Despite this success, Drysdale cautioned researchers intending to use interviews this way to carefully study and practice interview techniques. He also stressed the importance of limiting guiding questions in interviews so that they do not restrict or predetermine the final data.

Similarly, Benson (1984) was able to better understand students' and teachers' conceptions of biology by engaging in numerous lesson observations and detailed discussions with teachers and students within their classroom situations. The study successfully allowed students and teachers to register their conceptions instead of reacting to researchers' conceptions as is the case in survey studies.

Nadeau (1984), on the other hand, employed both the empirical-analytic approach and the situational-interpretive approach in an attempt to understand the meanings that students had regarding inquiry learning in chemistry, as well as the extent to which students were able to attain inquiry objectives while performing experiments in their chemistry laboratory. In this study, both quantitative and qualitative data were collected by means of paper and pencil tests, laboratory questionnaires and reports, tape-recorded interviews, and classroom observations. The two approaches proved to be very complementary and the various sources of data added to the validity and reliability of the findings.

Summary and Conclusion

From this review of the literature, it appears therefore that students' and teachers' perceptions of educational programs are important in that they determine to a great extent the success or failure of such programs. It is also evident that there has been some effort to study students' and teachers' perceptions of some school programs,

and teacher education programs in particular.

An examination of some studies related to the present study indicate that many of the studies were based on empirical-analytic approach, employing test instruments and highly structured questionnaires as major instruments for collecting data. On the other hand, it is clear from the critical review of the evaluation models and other approaches to evaluation that the empirical-analytic approach, although useful in providing valuable information about a program, is limited in revealing other important aspects of a program which impinge upon real life or social situations of such programs. Alternately, the situational-interpretive approach could be used to provide information on such aspects.

Since the substantive aspect of this study was an attempt to discern students' perceptions, an understanding of the perspective and the context of the students themselves was essential. On this basis, a "situational-interpretive" approach was considered appropriate as it takes into account the importance of context. In addition, an empirical-analytic approach was used to provide information that could not be provided by the situational-interpretive approach. It also facilitated a survey of a large population of the students. Using the two approaches--questionnaires and interviews--both qualitative and quantitative data were collected.

CHAPTER IV

RESEARCH DESIGN AND METHODOLOGY

This chapter is divided into three main sections. The first section deals with the major features of the research design, namely, nature of the study, identification of participants, and the development of instruments for data collection. The second section provides a detailed description of the procedure and the manner in which data were collected. The third section provides a description of the procedure of data analyses.

Research Design

This study is descriptive in nature, attempting to explore and reveal students' perceptions of their curriculum within their institutional settings. Two methods were used to collect data. A survey questionnaire was used to gather both quantitative and qualitative data from a large population of students, and semi-structured interviews were conducted with a small sample of students to gather more detailed opinions. In addition, some brief classroom observations were carried out to provide relevant perspectives for the interpretation of data.

Participants

One of the major considerations in the research design was to identify participants who might provide valid data for the purposes of the research. The first criterion was to have students who would have completed many activities of the curriculum, including at least one session of teaching practice. The second criterion was to have students who would have been willing to participate in the study.

A total of 90 finalist (last-year) students (89 males; one female) from Mkwawa, Kleruu and Dar-es-Salaam Colleges participated in the study by responding to the questionnaire. Eighty-four students out of the 90 indicated their willingness to be interviewed, but due to the small sample which was required, only 13 students (12 male, one female) were systematically selected according to group and subject combination to ensure that there was at least one student from each of these. The only girl in the population was sought as one of the interviewees. Table 3 presents a distribution of student participants by college and subject combination. In addition, three physics teachers, one from each college, participated, not as subjects of the study but as facilitators of classroom sessions.

Table 3

Participants Identified According to College and Subject Combination

Name of College	Subject Combination				Total
	Phy.-Math	Phy.-Chem.	Phys.-Geog.	Phy.-Biol.	
Dar-es-Salaam	$16_{(5)}$	-	-	-	$16_{(5)}$
Kleruu	$5_{(3)}$	$4_{(1)}$	-	$1_{(1)}$	$9_{(5)}$
Mkwawa	$37_{(1)}$	$11_{(1)}$	$15_{(1)}$	1	$65_{(3)}$
Total	$58_{(9)}$	$15_{(2)}$	$15_{(1)}$	$2_{(1)}$	$90_{(13)}$

( ) indicates the number of participants interviewed.

Structure of the Questionnaire

The questionnaire was developed by the researcher for use in this study. Items were constructed to incorporate some aspects from the planned curriculum and aspects identified in recent surveys relating to teacher education programs and curriculum studies in general. Aspects chosen include: personal interests; subject matter; pedagogical skills; teaching practice experience; resources; and support.

Part I of the questionnaire consists of items which elicited information concerning background and demographic characteristics of the students. Part II consists of controlled choice items which elicited information concerning students' personal interests in science and science teaching. Part III consists of open-ended items as well as controlled choice items which sought for students' opinions and views about the curriculum and instruction. Part IV sought for students' opinions on physics teaching practice. Part V sought for views on resources and other support systems, and Part VI invited students to express their views and opinions on various broad aspects of the physics curriculum. A sample questionnaire is provided in Appendix B.

In general, the questionnaire was used to obtain a broad survey rather than detailed students' views. Open-ended items were included to allow respondents to indicate to some degree the depth of their concerns and provide

insights into their interpretation of the curriculum.

One major problem of questionnaires, generally, and open-ended items in particular, has to do with validity. In this study validity meant the extent to which the questionnaire could uncover students' perceptions of the physics curriculum. Of particular significance was the relevance of the items to the research questions, the completeness of coverage of the overall subject, and the clarity of questions (Dawson, 1979).

With this realization, draft copies of the questionnaire were subjected to scrutiny by science education professors at the University of Alberta and science teacher educators in Tanzania, to establish its face validity and content validity. In addition, the questionnaire was pilot tested with five students at Dar-es-Salaam Teachers' College, to establish clarity of items in eliciting the kind of information required.

Interview Guideline

Interviews were intended to allow students to provide in more detail their views and opinions of the physics curriculum than they were able to in completing the questionnaire. A guideline consisting of a loose collection of questions was used to provide a degree of structure and to provide direction (Spradley, 1979; Gordon, 1980; Smith, 1981; Hook, 1981; Rist, 1982).

Questions were formulated using some categories

identified from questionnaire responses and covered some areas on the curriculum content and organization, instructional methods, assessment procedures, teaching practice, and teaching-learning resources. In addition, students were asked to discuss their views, through reflection, on the relevance and the usefulness of their experience in terms of a preparation to teach physics. They were also asked to elaborate on some of their experiences in implementing the curriculum, to discuss their perceptions of apparent strengths and weaknesses of the curriculum, and to suggest possible solutions to problems encountered in implementing the curriculum.

In general, the interview guideline was exploratory in nature and sought for more detailed information than that which was touched upon in the written questionnaire. A sample interview guide with an interview schedule is provided in Appendix C.

Observations

Several classroom observations preceding interviews were designed to familiarize the researcher with the structure of daily interactions and activities that take place during a physics lesson in a college situation. Such experience was considered useful in providing a frame of reference from which the students' views could be better contextualized. In addition, the experience was useful in enabling the researcher to generate ideas that were used to stimulate student reflection during the interview.

To produce detailed descriptions of classroom observations was not the intent in this study. However, a brief record of classroom interactions, including methodologies employed and the activities emphasized was maintained.

Procedure for Data Collection

Pre-entry

Initial contacts with heads of colleges, to inquire about the possibility of conducting the research, began in early October, 1984. This was followed by official letters explaining the purpose of the study and seeking permission to conduct the study from the Ministry of Education, Tanzania, and the Tanzanian National Scientific Research Council. By the end of January, 1985, all necessary permits had been obtained.

Validation of the Questionnaire

Between December 1 and December 20, 1984, draft copies of the questionnaire were distributed to 20 graduate students and five science education professors in the Department of Secondary Education, University of Alberta, for comments and criticisms. Many suggestions were provided concerning the length, structure, clarity and type of questions included. From these suggestions, the first draft was then revised.

Between January 21 and January 31, 1985, copies of

the second draft were distributed to five science teacher educators and two science curriculum developers from Dar-es-Salaam, Tanzania, for validation. They were all of the opinion that each item was relevant to the subject of study, and that all but two items were clear. The two items were then revised before a pilot test was conducted.

Pilot Study

Between February 1 and February 8, 1985, the questionnaire was pilot tested with five students at Dar-es-Salaam Teachers' College. Their responses to the questionnaire and their comments indicated that questions were clear and capable of eliciting student perceptions of the physics curriculum. Similarly, a trial interview conducted with one of the five students indicated that the procedure was appropriate and quite acceptable. There was no need at this stage to revise the questionnaire or the interview procedure.

Administration of the Questionnaire

The questionnaire was administered by the researcher to students in a class setting and at times arranged by the physics teachers. At the beginning of each administration session, the purpose of the study, and of the questionnaire in particular, was explained and students were informed that participation at any stage was voluntary. Those who were willing to participate in the interviews were

given the option of writing their names on their completed questionnaires, or contacting the researcher at the end of the questionnaire sessions.

On February 9, 1985, the questionnaire was administered to 16 students at Dar-es-Salaam College. Students appeared to be very serious and required an average of one and a half hours to complete the questionnaire. On February 12 and February 13, the questionnaire was administered to two groups, of 38 and 27 students respectively, at Mkwawa College. Three students found questions 23 and 33 unclear and requested clarification. Each group required an average of one and a half hours to complete the questionnaire. On February 14, 1985, the questionnaire was administered to nine students at Kleruu College for an average time of one and a half hours.

Classroom Observations

A total of nine physics lessons were observed--three in each college. For each lesson observed, a record of the nature of the lesson was kept, i.e. whether it was a lecture, a discussion, or a demonstration. In three observations some points for clarification were brought up with the teacher at the end of the lesson. At the end of each session, a brief interpretation of the lesson to indicate students' reactions and teachers' emphasis was made. A summary of some lesson observations made is provided in Appendix E.

Conducting Interviews

Interviews were conducted by the researcher between March 15 and May 4, 1985. Eleven students were interviewed individually, and two were interviewed simultaneously. Appointments for interviews were made in advance with the individual students and all were scheduled according to times that were most convenient for them. Arrangements were made with the physics teachers for the interviews to take place in vacant rooms that were near the physics instructional areas.

A copy of the interview guideline was given to each interviewee two days prior to the initial interview. Each interviewee was asked to read and think about the areas which were to be discussed. At the beginning of each interview, the purpose of the study and of the interview was briefly explained and students were assured of anonymity regarding treatment of data. All students were willing to be audio-recorded and all agreed to meet again for further discussion and verification of interpretations that would be made by the researcher.

During the interviews the guideline was followed, although not necessarily in the planned sequence. The order in which questions were asked depended largely upon the way in which the topic of discussion developed. Flexibility on the part of the researcher was felt to be a vital element toward the collection of meaningful, detailed opinions from

the students. After all questions had been discussed, the students were invited to make comments and suggestions regarding the physics curriculum or the interview in general, which they were often more than willing to do.

Initial interviews lasted an average of 45 minutes. Second meetings were rather short, lasting about 10 to 15 minutes, and were mainly utilized to discuss issues and questions raised as a result of the initial interviews. In addition to arranged interview sessions, informal conversations with the student participants occurred frequently during the researcher's stay on each college campus.

Following every interview, a word-for-word transcript was made from the audio-tape. Each transcript was then examined closely and re-read several times after which an interpretation was made by attempting to describe some specific meanings that the curriculum had for the student. An excerpt from a transcribed interview with student T along with the accompanying interpretation summary are found in Appendix D. Each interpretation was verified with the individual student. Eleven students were in complete agreement with the interpretations made. Two students suggested a few revisions on the interpretations made from their discussions.

Procedure for Data Analysis

Questionnaire Data

Data from the questionnaires were analyzed and presented in three ways. Data pertaining to personal and educational background in Part I and Part II of the questionnaire were tabulated and summarized to give a brief explanation of the characteristics of the student participants. Numerical data from items with scaled responses were coded; subsequently, frequencies and percentage distribution of the responses on the rating scales were determined. The method of "content analysis" suggested by Atkins (1984) was used in analyzing responses to open-ended items. This involved a process of reading through all the responses to a particular question, and as the responses suggested some categories, these categories were recorded. In this way a complete set of categories for an item was built up and all responses were coded according to categories. At times, some responses were split between several categories depending on whether several categories were implied in such responses. Also, as suggested by Atkins (1984, p. 256), some subcategories were combined into "higher-order generalizations."

The second stage in analyzing questionnaire data involved a process of putting together and deriving key themes from the numerically expressed findings and from the categories identified. All these themes were expressed in the

form of statements of students' perceptions of the physics curriculum as revealed from questionnaire responses.

Data from Interviews

As is usually the case with qualitative data (Bogdan & Bilhen, 1982; Rist, 1982), collection and analysis of interview data were, to a large extent, simultaneously performed. Considering the fact that the interview transcripts were a compilation of the word-for-word conversations, the act of interpreting these transcripts and the verification of the interpretations may then be considered as the first stage of analysis. In the second stage of analysis, a "thematic approach" (Firestone, 1980; Metz, 1981; Smith & Godfrey, 1969; cited in Rist, 1982) was used to identify key themes from the interpreted summaries. Finally, the themes were expressed in the form of statements describing the students' perceptions of the physics curriculum.

Final Analysis

The last stage of analysis involved a process of combining key themes identified from the interviews and those from the questionnaire responses, and from this synthesis trying to abstract meanings and focusing such meanings on the research questions. To achieve this, the procedure suggested by Hoffer (1983), in which van Hiele's framework for concept development in mathematics was adapted, involved the following processes:

1. Identifying common themes, contradictions, equivalencies and implications from key themes derived from interviews and questionnaires;
2. Identifying patterns and sequences that may relate to the research questions; and
3. Comparing and contrasting the abstracted interpretations to draw final interpretations and descriptions of students' perceptions.

Figure 1 represents diagramatically a summary of the process of data analysis.

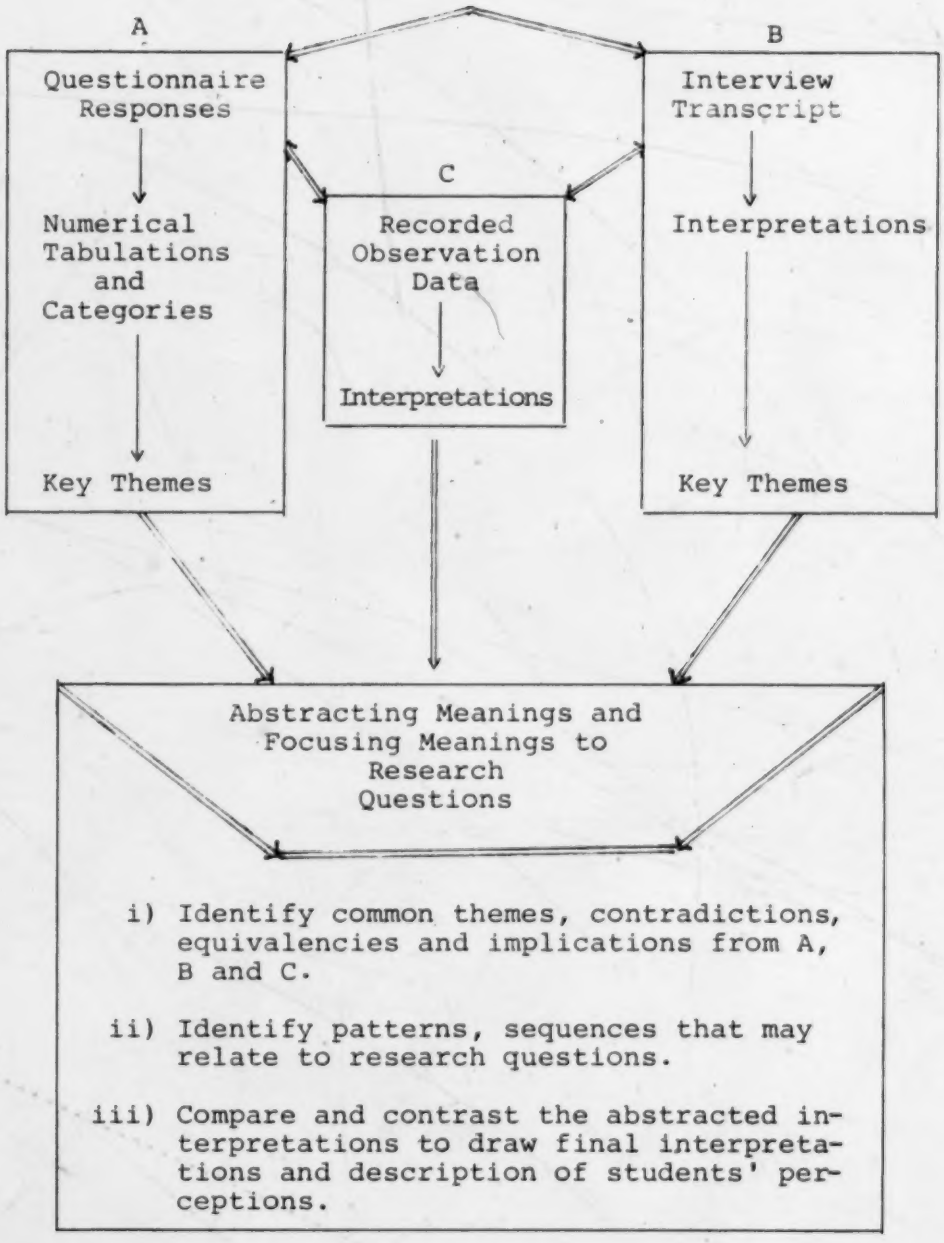
A
Questionnaire Responses
Numerical Tabulations and Categories
Key Themes
C
Recorded Observation Data
Interpretations
B
Interview Transcript
Interpretations
Key Themes
Abstracting Meanings and Focusing Meanings to Research Questions
i) Identify common themes, contradictions, equivalencies and implications from A, B and C.
ii) Identify patterns, sequences that may relate to research questions.
iii) Compare and contrast the abstracted interpretations to draw final interpretations and description of students' perceptions.

Figure 1. Flowchart Showing Processes and Stages of Data Analysis.

CHAPTER V

FINDINGS FROM THE QUESTIONNAIRE

In this chapter, findings from the questionnaire (see Appendix B) on student perception of the physics curriculum are presented in seven sections, as follows:

1. Characteristics of the students;
2. Students' interest in science;
3. Curriculum and instruction;
4. Teaching practice;
5. Resources and public support;
6. General comments and suggestions; and
7. Summary and key themes.

Characteristics of the Students

Of the total population of 90 students, a large majority of them (90.0%) were in the age range of 20 to 25 years, with the remaining (10.0%) being above 25 years of age at the time of data collection. Out of the 90 students who participated, only one is a female.

Sixty-five students (72.2%) entered college directly after four years of secondary education and were enrolled in the "high school" pre-service program. These students studied physics, educational psychology, and one other

science subject during their first two years of teachers' college. Twenty-five students (27.8%) were enrolled in the "ordinary" pre-service program of which 23 of these students entered college after six years of secondary education, while two students entered after four years of secondary education plus one year of private tuition, giving them an equivalence of six years of secondary education. In addition to their preparation to teach physics, each of the students specialized in the teaching of one other science subject; 58 (64.4%) students studied mathematics as their second subject, 15 (16.7%) studied chemistry, 15 (16.7%) studied geography, and 2 (2.2%) studied biology.

Students' Interest in Science

Most of the students (93.3%) indicated that they had a desire or strong desire to study and teach physics when they joined the teacher education program, and only a few (6.7%) indicated that they had no such desire. A large majority (95.5%) indicated that they found learning physics to be enjoyable or very enjoyable, and all students indicated that they used some or a great deal of their out-of-class time to study physics.

More than half of the students (65.6%) were of the opinion that their interest in physics and the teaching of it had increased since joining college. However, some students (15.0%) said that their interest had not been affected and still others (18.9%) said that such interest

had decreased.

Students from all the three colleges indicated that there did exist a science club or a science related "self-reliance" project in their colleges; and 41 students (45.6%) indicated that they were members of these clubs/projects.

Curriculum and Instruction

Concerning Relevance of Topics

In question 16, part one, students were presented with a list of topics that appear in the physics curriculum and asked to assess the relevance of each topic to their preparation using a four-point likert scale from "very relevant" to "irrelevant." There was also an additional option of "no opinion." The total number of students assessing each topic and the percentage number of students rating a topic as "fairly relevant" to "very relevant" is presented in Table 4. Topics are also rank ordered according to the degree of consensus among students that a topic was relevant.

There is a large majority of students (over 70.0%) rating all the topics as fairly relevant or very relevant. The first three most highly rated topics are all methods topics, and the last three are academic topics, with the exception of physics curriculum development. A significant number of students (5% to 10%) also indicated a "no opinion" for the topics micro-teaching, physics curriculum

Table 4

Percentage of Students Assessing Topics as Fairly or Very Relevant

Rank	Topic	Assessment	
		n*	%
1	Physics Teaching Preparation	86	96.5
2	Laboratory Management	79	94.9
3	Physics Teaching Methods	77	93.5
4	Forces	76	93.4
5	Measurements	80	92.5
6	Energy	79	91.1
7	Nature of Physics	85	89.4
8	Aims of Teaching Physics	83	89.2
9	Motion	72	88.9
10	Physics Teaching Aids	81	87.7
11	Structure of Matter	80	87.5
12	Electro-Magnetic Induction	79	87.3
13	A.C. Circuits	71	85.9
14	Assessment Techniques	79	84.8
15	Projects and Field Trips	78	83.3
16	Micro-teaching and Syllabus Analysis	88	83.0
17	The Earth	79	82.3
18	Wave Theory	83	78.3
19	Vectors	83	77.1
20	Physics Curriculum Development	83	72.3
21	Quantum Theory	87	71.3

n* This column indicates the number of students who assessed each topic.

NB -Not all the 90 students assessed every topic.

development and physics projects and field trips. In general, there was a high degree of consensus among students that all the topics listed in the curriculum are relevant to their preparation.

Concerning Difficulty

The second part of question 16 required students to rate the difficulty of the topics on a four-point likert scale from "very difficult" to "not difficult," with an added option of "no opinion." Table 5 presents the results by showing the number of students assessing each topic and the percentage of students rating a topic as "fairly difficult" or "very difficult." Topics are also rank ordered according to the degree of consensus among students.

A very large majority of students (93.2%) rated the topic on quantum theory as fairly or very difficult. About 52.0 percent of the students rated it as "very difficult." All other academic topics except measurement were rated as fairly or very difficult by many students (60.0% to 78.0%). All methods topics, excluding physics curriculum development, laboratory management and field trips and projects, were rated as fairly or very difficult by less than half of the students (29.6% to 49.4%). In addition to being rated the least difficult, micro-teaching also received a rating of "no opinion" from 15.5 percent of the students.

In general, many students expressed the opinion that the academic topics are fairly difficult or very

Table 5

Percentage of Students Assessing Topics as Fairly or Very Difficult

Rank	Topic	Assessment	
		n*	%
1	Quantum Theory	73	93.2
2	Vectors	86	77.9
3	Wave Theory	82	76.8
4	A.C. Circuits	82	72.0
5	Physics Curriculum Development	76	71.0
6	Forces	78	70.5
7	Electro-Magnetic Induction	73	67.1
8	Laboratory Management	76	65.8
9	Motion	76	64.5
10	Structure of Matter	77	62.3
11	Projects and Field Trips	71	62.0
12	Energy	75	61.3
13	The Earth	72	61.1
14	Physics Teaching Aids	79	49.4
15	Assessment Techniques	86	48.8
16	Physics Teaching Methods	77	44.2
17	Nature of Physics	75	42.7
18	Measurements	85	41.2
19	Aims of Teaching Physics	77	40.3
20	Physics Teaching Preparation	79	35.4
21	Micro-teaching and Syllabus Analysis	71	29.6

n* This column indicates the number of students who assessed each topic.

NB -Not all the 90 students assessed each topic.

difficult, while methods topics pose little or no difficulty.

Concerning Interest in Topics

In the third part of question 16, students were asked to rate the topics according to whether they found them very interesting, fairly interesting, of little interest or not interesting. Table 6 presents the percentage of students rating topics as fairly or very interesting. The actual number of students who rated each topic is also included.

Two topics--A.C. circuits and E.M. Induction--received very high ratings (91.4% and 90.0%, respectively) as being fairly or very interesting. There is also a large number of students (over 56.0%) rating all other topics as fairly or very interesting, except for the topics assessment techniques (37.0%), physics curriculum development (36.8%), and vectors (33.3%). In addition, 13.2 percent of the students who assessed the topic on physics curriculum development resorted to the "no opinion" option.

There is a high degree of consensus among students that all the topics except assessment techniques, physics curriculum development and vectors are interesting.

Concerning Emphasis

For question 17, students were asked to identify and list topics that they thought had been emphasized most during the course, while question 18 asked students to

Table 6

Percentage of Students Assessing Topics as Fairly or Very Interesting

Rank	Topic	Assessment	
		n*	%
1	A.C. Circuits	81	91.4
2	Electro-Magnetic Induction	80	90.0
3	Energy	77	83.1
4	Forces	74	82.4
5	Projects and Field Trips	80	81.3
6	Nature of Physics	79	81.0
7	Physics Teaching Aids	80	80.0
8	Motion	80	78.8
9	The Earth	85	74.1
10	Aims of Teaching Physics	74	73.0
11	Physics Teaching Methods	80	70.0
12	Laboratory Management	77	67.5
13	Micro-teaching and Syllabus Analysis	80	63.8
14	Structure of Matter	82	63.4
15	Quantum Theory	79	60.8
16	Wave Theory	81	60.5
17	Physics Teaching Preparation	81	58.0
18	Measurements	82	56.1
19	Assessment Techniques	81	37.0
20	Physics Curriculum Development	76	36.8
21	Vectors	84	33.3

n* This column indicates the number of students who assessed each topic.

NB -Not all the 90 students assessed each topic.

identify the relative emphasis they would recommend for those topics. For purposes of discussion, an analysis of the responses to the two questions is presented together to portray the number of times a topic is mentioned as emphasized relative to the number of times it is recommended for emphasis. In this way, the variations between observed emphasis and recommended emphasis can be compared. The results are presented in Figure 2.

After analyzing the data as presented in Figure 2, 10 was chosen as a significantly high enough frequency to be considered as an indication of high relative importance. There is a demonstrable consensus among students that nine academic topics were highly emphasized as compared to one methods topic (i.e. physics teaching preparation). On the contrary, eight methods topics were identified with a high frequency (10 to 25) for more emphasis and six academic topics with a frequency range of 10 to 19.

In question 19, students were asked to list topics that they felt should be added to the curriculum. Topics mentioned, in order of frequency, were: light (29), heat (26), current electricity (14), modern physics (10), electrostatics (7), magnetism (7), fluid mechanics (6), pressure (5), astronomy (4), sound (3), momentum (2), and kinetic theory (1).

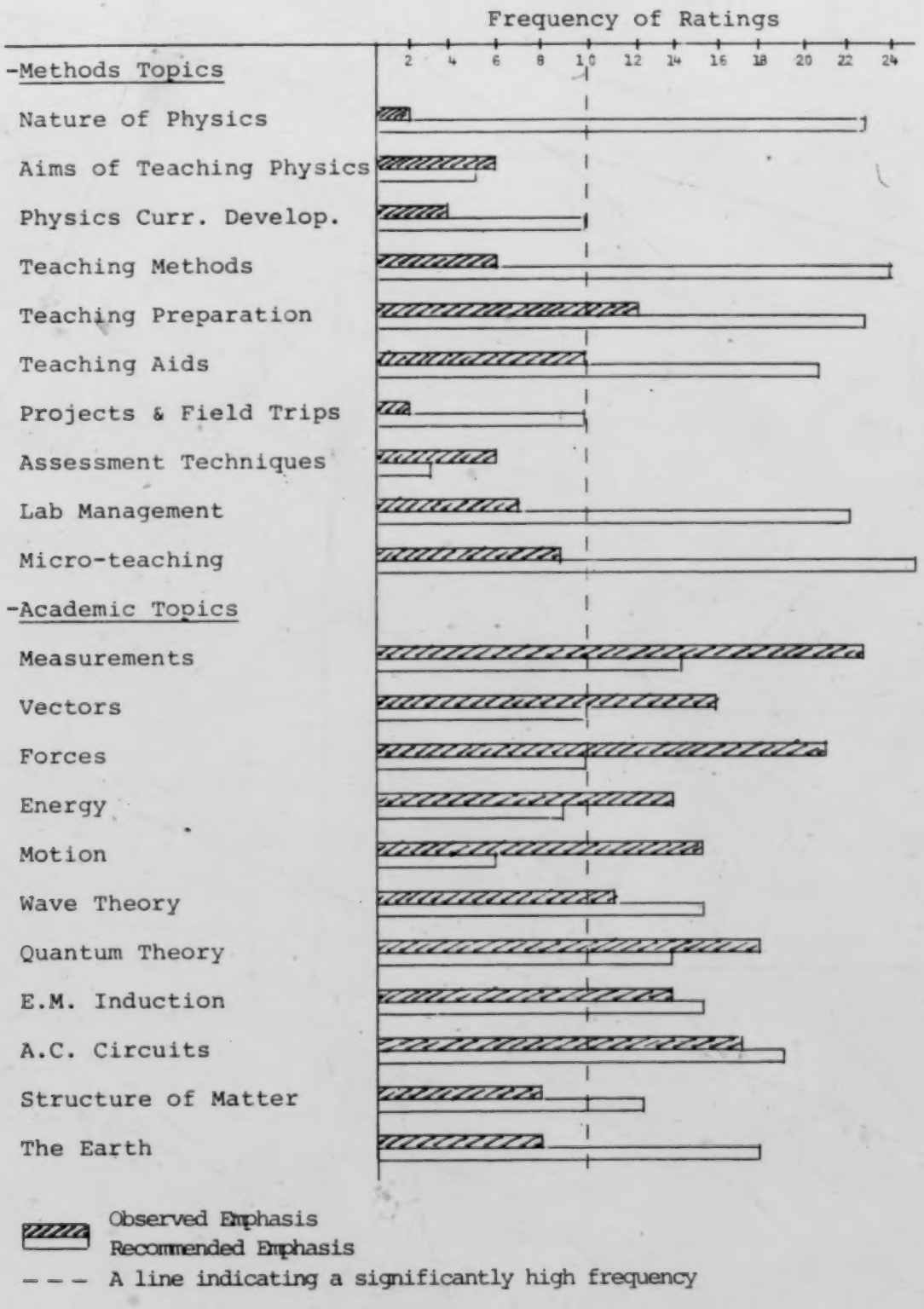

Figure 2. Students' Frequency Ratings of Observed and Recommended Emphasis on Topics.

Assessment of Instructional Methods

Question 20 had three parts which sought for students' assessment of the instructional methods according to effectiveness, adequacy and interest. To do this, students were presented with the six instructional methods which are suggested in the planned curriculum, i.e. discussing lectures, experiments, demonstrations, projects and field trips. They were then asked to use a four-point likert scale from 1(very effective/adequate/interesting) to 4(completely ineffective/inadequate/uninteresting) to rate each method accordingly. There was also an added option of 0(for no opinion).

Effectiveness of Instructional Methods

Table 7 presents students' percentage ratings of instructional methods according to effectiveness. The total number of students who responded to each item is included in the first column, and the methods are rank ordered according to the degree of consensus among students regarding the effectiveness of a particular method.

The majority of students (76.7%) rated discussions as very effective. A fairly large number (61.2%) rated experiments as very effective. Next on the list of very effective were field trips (48.7%), demonstrations (37.0%), and projects (37.0%). Only two students (2.5%) rated lectures as very effective; however, many of them (53.1%) were of the opinion that lectures were fairly effective. None of

Table 7

Assessment of Instructional Methods According to Effectiveness

Rank	Method	n*	ASSESSMENT (%)			
			Very Effective	Fairly Effective	Fairly Ineffective	Completely Ineffective
1	Discussions	86	76.7	21.0	2.3	-
2	Experimentation	85	61.2	29.4	9.4	-
3	Field Trips	78	48.7	39.7	11.6	-
4	Demonstration	81	37.0	49.4	13.6	-
5	Projects	81	37.0	45.7	17.3	-
6	Lecture	81	2.5	53.1	32.1	12.3

n* This column indicates the number of students who assessed each method.

the methods was assessed as being completely ineffective, except for lecture method, which was assessed thus by 12.3 percent of the students.

In general, there is a consensus among students that the methods of instruction are to a great extent effective.

Adequacy of Instructional Methods

Table 8 presents students' assessment of instructional methods according to adequacy (proportion of time spent). A large majority of the students (78.9%) were of the opinion that lectures were very adequate. A very small percentage of students (less than 7.0%) rated the other methods as very adequate. Many of the ratings on discussions were divided between fairly adequate (40.0%) and fairly inadequate (53.3%), whereas many ratings for experiments and demonstrations fell under fairly inadequate by 60.7 percent and 50.6 percent, respectively. Many ratings on projects were divided between fairly inadequate (44.8%) and completely inadequate (20.8%), and many ratings on field trips fell under completely inadequate (61.9%).

In general there is an outstanding consensus among students that all the instructional methods, except lectures, were not sufficiently utilized.

Table 8

Assessment of Instructional Methods According to Adequacy

Rank	Method	n*	ASSESSMENT (%)			
			Very Adequate	Fairly Adequate	Fairly Inadequate	Completely Inadequate
1	Lectures	76	78.9	13.2	7.9	-
2	Discussions	75	4.0	40.0	53.3	2.7
3	Demonstrations	77	6.5	26.0	50.6	16.9
4	Projects	67	6.0	28.4	44.8	20.8
5	Experiments	61	-	13.1	60.7	26.2
6	Field Trips	78	-	3.8	34.6	61.9

n* This column indicates the number of students who assessed each of the methods.

Interest in Methods of Instruction

In Table 9, students' assessment of instructional methods according to the degree of interest they find in them is presented.

Many students (73.6%) find discussions very interesting and many still (55.6%) find field trips very interesting. Concerning experiments, demonstrations and projects, many ratings (over 60%) were distributed almost equally between fairly interesting and fairly uninteresting. The majority of the students (72.2%) rated lectures as fairly uninteresting to completely uninteresting.

It appears, therefore, that students find discussions, field trips, experimentation, demonstrations and projects interesting, whereas they find lectures to be uninteresting.

Assessment of Time

In order to assess the time allocated to the physics curriculum, students were presented with a three-point scale of "not sufficient," "just sufficient," and "more than sufficient." Out of the 74 students who responded to the question, 54.1 percent indicated that the time was not sufficient, 43.2 percent indicated that it was just sufficient, and 2.7 percent indicated that it was more than sufficient. Of the students who indicated that time was not sufficient, more than 90 percent were those in the "high school" pre-service program.

Table 9

Assessment of Instructional Methods According to Interests

Rank	Method	n*	ASSESSMENT (%)			
			Very Interesting	Fairly Interesting	Fairly Uninteresting	Completely Uninteresting
1	Discussions	72	73.6	16.7	9.7	-
2	Field Trips	72	55.6	38.9	5.5	-
3	Experimentation	75	40.0	26.7	33.3	-
4	Demonstration	77	33.8	48.0	18.2	-
5	Projects	71	28.2	42.3	23.9	5.6
6	Lectures	72	-	27.8	47.2	25.0

n* This column indicates the number of students who assessed each method.

In general, the majority of students in the "high school" pre-service program were of the opinion that the time for the curriculum is not sufficient, whereas those in the "ordinary" pre-service program felt that the time was just sufficient.

Concerning their recommendations on the amount of time which should be allocated to cover the physics curriculum, a large majority of the students (85%) suggested eight hours or more per week, instead of the present 6.5 hours.

Assessment of Students' Performance

In question 23, students were asked to comment on the assessment of their performance in the physics curriculum. Seventy students responded to the question and submitted a total of 84 comments. Upon analyzing the comments, four categories emerged: (1) continuous coursework assessment; (2) assessment of knowledge of theory as against practical skills; (3) teaching practice assessment; and (4) final National Examination.

1. Continuous Coursework Assessment. As many as 27 comments referred to continuous assessment, many of which indicated that it is good, and reliable; some indicated that it is good but not enough variety in exercises given; and some comments suggested that it could be better if it included evaluation of day-to-day exercises instead of evaluations based on monthly and terminal tests only. The

trend of thought was that continuous assessment in principle is a good and reliable criteria, but has various shortcomings in the way it is conducted.

2. Assessment of Knowledge of Theory as Against Practical Skills. About 14 comments made referred to the lack of practical tests and exercises. Students were of the opinion that that which is assessed is mainly the theoretical aspect of the curriculum and the final national examination is also completely theoretical. There was a strongly expressed feeling that both continuous and final assessments should include both theoretical and practical achievements.

3. Teaching Practice Assessment. About 17 comments made referred to the assessment of teaching practice. The main idea was that it should carry more weight than the final examination.

4. Final National Examination. About 26 comments were made about the final national examination. Some students were of the opinion that there was too much weight given to the final examination, some thought that the examinations are never very reliable and do not accurately measure the extent to which a student has mastered the curriculum.

It appears therefore, that students accepted the three main methods of assessing their performance, i.e. continuous coursework assessment, teaching practice assessment, and final national examination. What they saw as

shortcomings were the details of each procedure, such as the quality and quantity of exercises and tests, the reliability of tests and examinations, and the extent to which theory and practice were evaluated. Also, students were of the opinion that the weight given to the final examination is excessive and that it should be reduced.

General Comments Concerning Curriculum and Instruction

In question 24, students were asked to give their general comments about the curriculum and instruction. Eighty-three students responded to the question and submitted 110 comments. Upon analyzing the comments, six main categories emerged: (1) theory vs practicals; (2) curriculum structure and implementation; (3) about teachers; (4) teaching methods; (5) the length of the curriculum; and (6) about resources.

1. Theory vs Practicals. About 31 comments (28%) were directed toward the lack of integration of theory and practice in the curriculum. Comments, such as "instructions are too theoretical," "lack of practicals is discouraging," "no emphasis on practicals and experiments," were quite frequent. In general, students commented that the curriculum does not integrate theory with practice; rather, it places more emphasis on physics theory.

2. Curriculum Structure and Implementation. Thirty comments referred to this aspect. Some students commented that there was too much academic content covered and too

little emphasis on "important methods topics," such as micro-teaching and syllabus analysis. Some comments reflected that the curriculum was not being followed strictly.

3. About Teachers. About 23 comments portrayed the view that teachers were not committed, not qualified, not taking their teaching seriously, and were also lacking in numbers.

4. Teaching Methods. Fourteen comments were made which indicated that there was a limited variety of methods used in teaching.

5. The Length of the Curriculum. Nine comments referred to the curriculum as being "too long," "too ambitious," and "impossible" to be covered in the time allotted.

6. About Resources. Three comments were made about a serious lack of various reading materials and equipment for carrying out experiments and demonstrations.

Teaching Practice

General Information

Findings from Part I and Part II of the questionnaire indicated that many students (76.6%) conducted most of their teaching practice in the lower levels (forms 1 and 2) of secondary schools, with fewer students (23.4%) experiencing the higher forms (forms 3 and 4). On the other hand, when students were asked to indicate the levels at which they prefer to teach physics, many of them (70%) indicated the

higher forms. The main reasons that students gave for their preferences to teach higher forms included, in order of emphasis:

1. Students in higher forms already understand some basic concepts in physics;
2. Students understand English;
3. Students are fairly mature;
4. Students value education;
5. Students have interest in physics; and
6. Topics covered in higher levels are challenging.

For those who indicated a preference to teach lower levels (25%), their reasons included, in order of priority:

1. Topics covered in lower levels are easy;
2. Students in lower forms are disciplined;
3. One can start from basics and build up students' foundation; and
4. Students not in panic of exams like those in higher forms.

Four students (about 5%) said that they would prefer to teach all levels in order to gain a wide experience. Of these four, one student stated that he would prefer to teach all levels by working with a particular class from form 1 to form 4. In this way he felt that he could better understand the problem of the students and would then be able to help them and observe their achievement at the end of form 4.

In responding to the question concerning the type of school (by sex) that they would prefer to teach physics in, 49 out of the 82 students (60.9%) who responded indicated co-educational schools, 29 students (35.4%) indicated boys' schools, and three students (3.7%) indicated girls' schools.

Concerning the Length of Teaching Practice

Students in the two-year "ordinary" program had two sessions of teaching practice, and the majority of students (83%) had eight to nine weeks of actual teaching. On the other hand, students in the "high school" program had one session of teaching practice, and the majority of the students (92%) indicated that they had four to five weeks of actual teaching.

Preparation before Teaching Practice

In question 26, students were asked to assess their preparation in various aspects of knowledge and skills before their teaching practice. A four-point likert scale from "excellent" to "poor" was utilized. Table 10 presents students' assessment of the various aspects. The number of students assessing each aspect is indicated and ratings are recorded in percentage. The various aspects are also rank ordered according to the degree of consensus among students in perceiving that they had a "good" or "excellent" preparation for teaching practice.

Lesson preparation was the most highly rated area of

Table 10

Students' Assessment of Their Preparation before Teaching Practice

Rank		n*	ASSESSMENT			
			Excellent %	Good %	Satisfactory %	Poor %
1	Lesson Preparation Skills	81	37.0	53.1	9.9	-
2	Knowledge of Content	78	18.0	62.8	19.2	-
3	Classroom Management	80	28.8	50.0	21.2	-
4	Instructional Skills	78	10.3	53.8	35.9	-
5	Assessment Techniques	80	6.3	53.7	40.0	-
6	Knowledge of Teaching Methods	78	9.0	46.1	44.9	-
7	Conducting Experiments/Demonstrations	79	2.5	20.3	65.8	11.4

n* This column indicates the number of students who assessed each aspect of the teaching practice preparation.

preparation with 37.0 percent of the ratings as excellent and 53.1 percent as good. Next on the list was knowledge of content and classroom management. However, the aspect concerning skills to conduct experiments and demonstrations was rated lower with 65.8 percent of ratings as satisfactory and 11.4 percent of ratings as poor. No other aspect had a rating of poor.

Concerning Supervision

In responding to question 27 concerning the number of times visited by their teachers for supervision in their last session of teaching practice, many students (50.6%) indicated that they had four supervisions, 25.3 percent of the students indicated that they had three supervisions, 12.7 percent had two supervisions, 6.3 percent had five supervisions, and 2.5 percent of them had one supervision. There were six students (8.0%) who felt that the number of supervisions they had were more than sufficient. On the other hand, many students (53.3%) felt that the number of supervisions they had were just sufficient, and 29 students (36.7%) felt that they never had sufficient supervisions.

When asked to recommend the number of times they would have liked to be visited for supervision, many students (43.6%) indicated five supervisions, 27.3 percent indicated six, 23.6 percent indicated four, and 5.5 percent indicated three supervisions. However, this question was responded to by only 55 students.

In question 30, students were asked to assess the usefulness of the supervisions using a three-point scale consisting of "very useful," "fairly useful" and "not useful." A large majority of the students (97.4%) rated the supervisions as "fairly useful" or "very useful." Only two students (2.6%) rated the supervisions as "not useful."

In question 31, students were asked to rate their confidence toward teaching, using a three-point scale of "very confident," "fairly confident" and "not confident." Seventy-nine students responded to the question; 63.3 percent indicated that they were fairly confident, while 36.7 percent indicated that they were very confident to teach physics.

Problems during Teaching Practice

Question 32 sought to find problems that students encountered in teaching physics during their teaching practice sessions. This question received the highest number of responses (88 students), and those who responded made several detailed comments. Totally, 185 problems were listed; when analyzed, four categories emerged: (1) inadequate resources; (2) secondary school students' problems; (3) nature of student teachers' problems; and (4) administrative problems.

1. Inadequate Resources. This was the most frequent category with about 47 percent of the responses being directed to it. Some of the resources which were mentioned frequently as being lacking or inadequate include, in order

of priority: experimental equipment, textbooks, reference books, and teaching aids.

2. Secondary School Students' Problems. About 35 percent of the problems listed had to do with a number of areas in which the secondary school students demonstrated weaknesses. The weaknesses mentioned included, in order of frequency, problems in understanding English, weak background in physics and mathematics, lack of interest, and negative attitudes toward physics. Discipline was also identified by two students as being a problem.

3. Nature of Student Teachers' Problems. About 12 percent of the problems listed had to do with the student teachers' lack of experience in experimenting skills, finding the topics to teach difficult, and financial constraints.

4. Administrative Problems. These included large class size, lack of adequate permanent teachers in a school, and little cooperation from class teachers.

In general, therefore, students identified the problems which they encountered during their teaching practice to be: inadequate resources; their students' problems in English; their students' weak background and lack of interest; their own problems of lack of some skills in conducting experiments; and also, some administrative problems in schools.

Criteria for Assessing Teaching Practice

Only 53 students responded to question 33 concerning the criteria which were used in assessing their teaching practice. Several items were listed as being important in judging competence in teaching which included, in order of frequency, knowledge of subject matter, personality and appearance, lesson preparation, classroom management, lesson presentation skills, use of teaching aids, use of language and voice, use of black-board, use of various teaching methods, class participation, and skills in conducting experiments/demonstrations.

When asked to recommend criteria which would be more suitable for assessing the teaching practice, many students (54.4%) maintained that the existing criteria were suitable just as is. About 22.8 percent of the students indicated the same criteria be used, but that only physics teachers should assess physics lessons. Additional qualifications to the procedure used included a need for assessing teachers to pay more attention to the effectiveness of the lesson rather than other trivial things, assessment of how well the student teachers integrate into the school community, and a need to involve physics teachers in the schools in making the assessment.

Recommendations for Additional Methods of Preparing for Teaching Practice

In question 35, students were asked to offer suggestions as to how the college might better prepare students for teaching practice. A total of 88 suggestions were submitted which, when analyzed, resulted in six main recommendations, as follows:

1. Micro-teaching and single-lesson teaching practice should be emphasized;
2. Students should be taught how to set up experiments;
3. Students should be assisted in developing skills to construct teaching aids;
4. There should be more emphasis on various teaching methods;
5. There should be time for reviewing and analyzing the secondary school syllabus; and
6. College tutors should present a variety of model lessons.

Resources and Public Support

Adequacy of Resources

In question 36, students were asked to make an assessment of the adequacy of some of the physics teaching/learning resources in their colleges. A four-point likert scale ranging from "completely adequate" to "completely inadequate" was provided. Table 11 presents students' ratings.

Table 11

Students' Assessment of Adequacy of Facilities and Equipment

Facility or Equipment	n*	ASSESSMENT (%) Completely Adequate	Fairly Adequate	Fairly Inadequate	Completely Inadequate
Space in the Laboratory	80	46.3	37.5	13.8	2.4
Laboratory Equipment	77	6.5	49.5	28.6	15.4
Physics Textbooks	78	7.8	30.8	41.0	20.4
Other Physics References	81	3.7	23.5	46.9	25.9

n* This column indicates the number of students who assessed each aspect.

Students' ratings on space in the laboratory were almost all distributed between completely adequate (46.3%) and fairly adequate (37.5%). Concerning laboratory equipment, physics textbooks, and other physics references, there was a high degree of consensus among students that such resources were completely inadequate to fairly adequate. In general, students were of the opinion that all resources except space in the laboratory were insufficient.

In question 37, students were asked to state whether they recognized an effort to ensure that facilities and equipment were available. Comments were almost evenly divided between no effort recognized (47%) and some effort recognized (53%). Those who indicated that they recognized some effort qualified their position by listing the efforts of physics teachers in repairing equipment, efforts of school administration and librarians to order books, and efforts by teachers to emphasize the construction of simple teaching aids by students.

Suggestions to Alleviate Problem of Facilities

Suggestions made by students concerning ways to alleviate the problem of facilities were grouped into three categories, namely: (1) national plans; (2) use of existing equipment; and (3) effort by colleges.

1. National Plans. Many of the suggestions made were directed toward national plans. Students were of the opinion that there was a need for more priority to be given

to education and, in that way, there would be more money to buy equipment for schools. Also, it was indicated that there should be plans at the national level to encourage SIDO (Small Industries Development Organization) to construct some local school equipment.

2. Use of Existing Equipment. Some students were of the opinion that some of the equipment existing in their colleges should be used more carefully than had previously been the case, and that the equipment should be checked and maintained from time to time. Students also suggested that existing school equipment should be equally distributed among the colleges and schools.

3. Effort by Colleges. The third suggestion was directed toward the colleges. Some students were of the opinion that colleges could alleviate the problem regarding a lack in reading materials by having teachers prepare some handouts and various articles. Further, the science teachers in colleges could encourage and help their students to construct some teaching aids from locally available materials. Five students suggested that students in colleges should be required to buy their own books.

In general, students saw the problem of facilities and equipment as a national problem, and that colleges could play a role in alleviating the problem.

Public Support

In question 39, students were asked to assess the importance given to science relative to other subjects by education policy makers and administrators, political leaders, and the community at large. Students used a three-point scale: 1(more important); 2(equally important); and 3(less important), with the added option of "don't know." Table 12 presents a summary of the students' assessment.

Many students (above 54.0%) were of the opinion that policy makers and administrators, and the community at large regarded science as being more important than other subjects. However, only 18.8 percent of the students felt that political leaders regarded science as more important than other subjects.

When asked to explain how the importance of science was reflected in practice, the majority of students (71.4%) were of the opinion that the importance of science was not usually reflected in practice. The reason they gave for their assessment was that the importance was only talked about in public speeches; but practically, there was little to support it. Some gave as an example salary scales for science and mathematics teachers, which are a bit higher than for other teachers at the point of first appointment. Students felt that the small difference was meant to attract people into teaching science, but the difference was considered to be negligible. The few students (9.5%) who

Table 12

Students' Assessment of Importance Given to Science Relative to Other Subjects

Groups of People	n*	ASSESSMENT (%)			
		More Important	Equally Important	Less Important	Don't Know
Policy Makers and Administrators	77	54.4	26.0	14.3	5.3
Political Leaders	80	18.8	35.0	32.5	13.7
The Community	77	61.0	31.2	7.8	-

n* This column indicates the number of students who assessed each group of people.

indicated that the importance of science was reflected in practice qualified their statements by presenting the fact that hours allocated to all science subjects in a school are usually slightly more than the hours allocated for other subjects. Twelve students (19.1%) maintained that science was treated as being equal in importance to other subjects.

Comments and Suggestions

Question 40 sought for students' general assessment of their preparation toward becoming physics teachers, using a three-point scale of "very successful," "fairly successful" and "not successful," and thereafter giving further explanation for their assessment. Responses from 79 students were divided as follows: 19.0 percent of students rated the preparation as being very successful, 77.2 percent rated it as being fairly successful, and 3.8 percent rated it as not being successful. Further explanations given to qualify success were directed toward students' personal interest and determination to become physics teachers. Other explanations given to qualify success included knowledge of content and methods and skills in teaching. For those who felt that the preparation was not so successful, they qualified their assessment by the following statements: "not mastered practical experience," "not mastered the secondary school syllabus," "tutors are not serious," "poor college conditions," and "lack of interest."

Suggestions for Improvement

Questions 41 and 42 sought for students' views of the curriculum and suggestions as to how to improve it and the preparation of physics teachers in general. An analysis of students' suggestions resulted in seven major categories which are briefly summarized in order of priority: (1) Curriculum structure and instruction; (2) assessment of students' achievement; (3) teachers; (4) resources; (5) college conditions; (6) time; and (7) students.

1. Curriculum Structure and Instruction. More than half of the comments made were directed toward the structure of the curriculum, the emphasis on various aspects of the curriculum and the instructional methods used. Concerning structure, students suggested that the academic part of the syllabus should concentrate on topics covered in the form 1 to 4 physics syllabus and not the form 5 to 6 syllabus. Concerning emphasis, students were of the opinion that the curriculum should put more emphasis on: methods topics rather than academic ones; practical work in the laboratory and in the schools rather than book theory; and more on the personality and the discipline of student teacher rather than knowledge in physics. Students also suggested that instructional strategies should be improved by increasing the amount of discussions and laboratory activities for students rather than relying on the use of lectures. In order to increase students' interest, it was suggested that colleges should organize science meetings and field trips.

2. Assessment of Students' Achievement. There were a number of suggestions concerning the need to have both practical and theoretical exams in order to more meaningfully measure students' achievement rather than the present system of theory exams only. Other students felt that there was a need to give more weight to teaching practice and coursework assessments rather than to the national final examinations. Two students mentioned that the relative weight given to each aspect of students' assessment should be made known to the students.

3. Teachers. The students stressed a need to have sufficient qualified and committed teachers for teaching the physics curriculum.

4. Resources. The need to have a variety of up-to-date books and other reading materials, equipment and teaching aids was suggested by almost all the students.

5. College Conditions. Several suggestions made referred to the need to improve students' living conditions such as food, financial allowance, hostel facilities, and social life while in college.

6. Time. A number of students, particularly those in the three-year program, indicated that it was "impossible" to complete the advanced secondary school syllabus as well as the diploma syllabus within the three years. Five students suggested that 3.5 years was required, and one student suggested four years for the high school pre-service diploma program. Many other suggestions about time referred

to a need to increase the teaching practice time from one session to two, for the three-year program.

7. Students. A number of students in the two-year program suggested that students should be better prepared in their advanced-level physics course.

Comments about the Questionnaire

In question 43, students were invited to appraise the questionnaire. Of the 66 comments made, 59 were very positive, two were suggestive, and five were fairly negative. Some of the positive comments were: "well planned," "useful and educative," "very interesting," "seems valid," "very good" and "important questions." Negative comments included: "too long and difficult," "some questions were not clear," "not enough questions" and "insufficient space for writing responses to open-ended questions." The two suggestions included: "questionnaire good but should include questions about teachers' and students' home problems" and "questionnaire should include questions on learning and teaching physics."

In general, the comments given about the questionnaire indicate that students found it useful and educative.

Summary and Key Themes from Questionnaire Responses

The following section summarizes the key themes derived from questionnaire responses.

Curriculum Content and Organization

1. There was a high degree of consensus among students that all topics in the curriculum and more so the methods topics are relevant to their preparation.
2. Students were of the opinion that academic topics in the curriculum are fairly to very difficult while methods topics are not difficult.
3. Students indicated that all topics except assessment techniques, physics curriculum development and vectors are interesting.
4. There was an indication that the curriculum was placing more emphasis on academic topics than methods topics.

Instructional Methods

5. In general, there was a consensus among students that discussions, experimentation, demonstrations, field trips and projects are very effective and interesting methods of instruction. However, students sensed that these methods were fairly or completely inadequate in the course.
6. Students, on the other hand, indicated that lectures were not very effective, were not very interesting, but were very frequently used.

Time

7. The majority of students in the three-year "high school" pre-service program were of the opinion that the time for the curriculum is not sufficient, whereas those in the "ordinary" pre-service program felt that the time was just sufficient.

Assessment Procedures

8. Students were of the opinion that continuous coursework and teaching practice assessments were in principle good criteria of assessing their performance, but are not given enough weight.
9. Students expressed some concerns that the final examinations are not very valid and reliable, very theoretical, and are given too much weight.

Teaching Practice

10. There was a consensus among students that the curriculum was strongest in providing them with skills in lesson preparation, skills in lesson presentation, knowledge of content, classroom management skills, and assessment techniques, but did not prepare them well in skills to conduct experiments and demonstrations.
11. The criteria used for assessing teaching practice was considered well founded, and supervisions were viewed as useful.
12. Students identified some major problems that they

experienced during teaching practice, namely: inadequate physical facilities and resources; secondary school students problems in understanding English; weak background in physics and mathematics; lack of interest in physics; administrative problems in the schools; and student teachers' personal and financial problems.

Resources and Public Support

13. There was a strong indication that physical facilities and resources were inadequate in the colleges and that there was, practically, little public support to alleviate this problem.

Suggestions

14. Students suggested that the curriculum should put more emphasis on methods topics, practicals, and instructional methods that involve students in discussions and activities.
15. Students also suggested that the final examination should include practicals, and that coursework and teaching practice assessments should carry more weight than the examination in the final grading.
16. Students expressed strongly the need for more qualified and committed teachers, adequate resources, and improved living conditions for students.
17. Students also suggested that the time for the three-year program should be increased and that there should be two sessions of teaching practice.

18. There was a suggestion that students should be well prepared in their advanced-level physics so as to have a solid grounding for the diploma physics course.

CHAPTER VI

FINDINGS FROM THE INTERVIEWS

This chapter presents students' perceptions of the physics curriculum as revealed through the interviews. An attempt is made to put together some of the views, opinions and concerns expressed by the students. Quotations from transcripts are included in order to substantiate and to retain the advantage of the rich data.

The chapter is divided into eight sections. The first section provides a brief description of the characteristics of the students who participated in the interviews. Sections two through seven present the major themes that emerged as a result of analyzing the interview data. The themes are grouped into "higher order themes" and presented under six topic headings, as follows:

1. Curriculum Content and Organization;
2. Instructional Methods;
3. Preparation for Teaching Practice;
4. Resources and Public Support;
5. Assessment Procedures; and
6. Comments and Suggestions.

The last section summarizes the themes in terms of students' perception of the curriculum.

Characteristics of the Students

Of the total sample population of 13 students who participated in the interviews, nine were in the physics-mathematics subject combination groups, two were in the physics-chemistry groups, one was in the physics-biology group, and one was in the physics-geography group. To preserve the anonymity of the students, each one has been assigned a letter code (J, K, L, M, N, P, Q, R, S, T, X, Y and Z).

Physics-Math Students

Students K, M, N, P, Q, R, S, T and Z belonged to the physics-mathematics groups, and all, with the exception of student "P", are males. Student Z was in the three-year program and the other eight students were in the two-year program.

Student K. Student K was 23 years old at the time of conducting the interviews. He entered college directly after six years of secondary education. "K" had been a member of an "electronics" club in the secondary school which he attended, and was a member of the science club during his college years. While in secondary school (form 1), he participated in a national science fair where he displayed a simple radio transmitter model which he and two other students had constructed. Student K indicated that he had a strong desire to study and teach physics when he joined the teacher education program, and that he still

maintained that desire.

Student M. Student M was 23 years old and entered college directly after six years of secondary education. "M" said that he found learning physics very enjoyable in secondary school but less enjoyable in college. During his first year at college, he used to attend the science club meetings but decided to quit after realizing that the club was not as active as he had expected it to be.

Student N. Student N was 24 years old and entered college directly after six years of secondary education. "N" said that his interest in teaching physics has steadily increased since joining college. Students "N" and "M" were interviewed simultaneously.

Student P. Student P was 21 years old and entered college directly after six years of secondary education. "P" had not volunteered for interviews at the time of the administration of the questionnaire. On being approached by the researcher at a later time, she promptly volunteered for the interviews. Student P said that she found learning physics and mathematics very challenging and wanted to become a teacher of these subjects. "P" indicated that her secondary school teachers had presented physics very abstractly and that she was preparing to teach it differently.

Student Q. Student Q was 22 years old and entered college directly after six years of secondary education. "Q" was a member of the science club in his college and

entered the teacher education program after failing to get into engineering at the University of Dar-es-Salaam. "Q" developed a great interest in the teaching of physics after his first session of teaching practice.

Student R. Student R was 23 years old and entered college after four years of secondary education, followed by one year of private tuition. "R" indicated that he was very much interested in becoming a teacher and liked physics more than any other science subject.

Student S. Student S was 24 years old and entered college after six years of secondary education plus one year of part-time teaching at a secondary school. "S" had developed a great interest in teaching only after his part-time teaching and decided to join the teacher education program. Student S achieved the highest marks in all the physics and mathematics tests he took at the college. "S" was very eager in contributing his opinions about the curriculum.

Student T. Student T was 22 years old and entered college directly after six years of secondary education. He appeared very concerned about the emphasis on final examinations in the program. "T" indicated that he found learning physics by experimentation to be very enjoyable.

Student Z. Student Z was 21 years old and entered college directly after four years of secondary education. "Z" said that he joined the program not so much for the interest he had in teaching, but for the high school level education it offered. "Z" indicated that the high school

diploma program had an advantage over the ordinary high school program in that students received some financial allowance from the ministry of education. Student Z's interest in teaching had increased steadily since joining the program.

Physics-Chemistry Students

Students L and Y belonged to the physics-chemistry groups and are both males.

Student L. Student L was 22 years old and was in the two-year program. "L" indicated that he had found learning physics enjoyable at secondary school, but not so much at college. Student L said that he had always wanted to become a teacher.

Student Y. Student Y was 20 years old and entered college after four years of secondary education. "Y" said that he chose to join the diploma-high school program because it offered more places for Form 4 school leavers than the ordinary high school program. Student Y's interest in teaching has developed after the teaching practice. "Y" appeared to express his views with a lot of reservations.

Physics-Biology Student

Student J belonged to the physics-biology group. He was in the two-year program and was 21 years old. Student J said that he liked physics and had great interest in teaching.

Physics-Geography Student

Student X belonged to the physics-geography group. He entered college directly after four years of secondary education and was 22 years old. Student X said that he had a great interest in science and science teaching. He indicated a strong concern for the apparent lack of creativity in the science programs at secondary school level, as well as at the college level. "X" was very eager to contribute his opinions about the physics curriculum.

Curriculum Content and Organization

The first area of discussion on the interview guideline (see Appendix C) was concerned with the subject matter included in the curriculum, its nature, organization, emphasis, difficulty, and its relevance to the preparation of becoming physics teachers. In expressing their views, all students but one made no distinction between the curriculum content as planned and as translated in their lessons. Very often students were basing their views and concerns on the curriculum as they experienced it during their physics lessons. The four key themes that emerged are presented in this section.

Content is Mostly Theoretical

The most outstanding concern which was expressed by all the students, although in varied forms, was about the content being greatly theoretical with little or no "hands

on" experience or practical application. This seemed to be quite contrary to what students understood physics to be or from what they expected from a physics course of any kind. Students said that they learned most of the topics theoretically and as a result it became difficult for them to understand some of the concepts. From this theoretical approach, students also said that they failed to see the usefulness or the application of the knowledge gained. Some of the students' comments cited below illustrate this view.

> . . . and for many topics we only learn them theoretically, . . . and therefore you find that there is no understanding. Because a theoretical concept without practical application . . . it is difficult to get it. (Student Y)

> . . . because if you compare practicals to theory you will find that many topics . . . we learned them theoretically. (Student P)

> For example, we don't do practically most of the topics, . . . we just do it theoretically. So it is difficult for us to know sometimes the description of something. (Student J)

Even in the cases where students had some practical experience they felt that the practice and the theory were fragmented; as Student N commented, "But again, the lack of integration of theory and practice makes it difficult to understand."

Students appeared to be very dissatisfied with the lack of practical skills which they thought were very vital, not only for their personal understanding of the physics concepts, but also for building their confidence and skills in the teaching of physics and for conducting experiments

with their students. Such concerns were expressed by nearly all the students. Comments included:

> And for sure, one most important thing which is lacking in this course is practicals. If there are supposed to be any practicals in the curriculum, at least our teachers, . . . in our college we are not aware of it. (Student K)

> . . . but I can say that some of us will be getting our diplomas . . . but when we get to the schools we will fail to conduct even a simple experiment . . . though we will have mastered theory . . . so we only have laboratories but no experiments. (Student Q)

> The curriculum does not meet our requirements because we don't get practical experience, . . . for example, to use lab equipment to demonstrate. (Student J)

In order to probe more deeply into their feelings about the nature of the content, students were asked to explain the reasons for the curriculum being presented with a theoretical emphasis. Some of the reasons given were attributed to teachers' lack of interest and teachers' lack of competence in setting up experiments. A typical student comment is as follows: "Teachers find it easy to impart theory in books but find it difficult to show the application of such theory." A second reason given had to do with the structure of the exams. Many students felt that teachers did not pay much attention to practicals as they are not examined in the final examination; instead, teachers paid attention to theory which is examined at the end of the course. This is illustrated by Student P's comment:

> Because in the final examinations we have no practical work . . . so I think in colleges

> there are no practicals . . . because if there are practical questions in the exam then we will have to be prepared. (Student P)

In contrast to other students' cries for practicals of any kind, Students X and Z thought that even the few practicals they had were not useful. Their opinion was that the experiments conducted usually duplicated previous experiments and as a result there was nothing new. Their comments were as follows:

> Now what is surprising is that . . . even the few experiments we do . . . they cannot help you to get or learn something new. It is only a repetition of some experiments which have been done by others . . . and you go to the lab just to repeat them. (Student X)

> By practicals, I don't think it is meaningful to perform experiments for the sake of it . . . but to research on certain areas of physics. (Student Z)

When students were asked to explain what "practical work" meant to them and to describe the sort of things they looked for in a practical lesson, some of them referred to the idea of a "hands on" experience; some preferred going through the experiments that are suggested in the secondary school physics syllabus and being able to set them. However, two students said that they would prefer experiments to test their own hypotheses. Samples of students' statements are given below:

> By practicals I mean . . . the idea of getting used to doing experiments . . . in all the topics we are going to teach . . . and if we understand the experiments . . . then we are going to teach better. . . . to understand the experiments better I mean also to be able to set them. (Student R)

> They should put emphasis to do a lot of exercises in practicals . . . so that when one goes out to teach he will be confident in conducting practicals. (Student K)

> By practicals . . . I mean getting the chance to plan, set and perform experiments by ourselves. (Student J)

In general, therefore, students perceive the physics curriculum as being very theoretical with little or no practical application. The curriculum as presented does not offer a "hands on" experience or develop skills in conducting experiments.

Difficulty Level of the Course Content

When students were asked whether they found the subject matter easy or difficult to understand, there was a general view that most of the topics were not difficult. Many students felt that topics were not difficult because much of the content was a review of advanced secondary physics. Only a few topics were identified as being difficult, and these were wave theory, quantum theory, electronics, and earth physics. When asked to describe the kind of difficulty experienced in these topics, students identified five problems, namely:

1. Topics are treated too mathematically, such that one loses the whole idea of physics;
2. Failure to get a real picture of the concept without a practical demonstration;
3. Failure to see practical application of the knowledge presented;

4. Topics were skipped in high school therefore students lack the background; and
5. Topics are taught very fast.

It is evident from these responses that students perceive the content of the curriculum as not being difficult, and that some difficulty in a few topics arise due to "inappropriate" presentation or lack of good background in high school physics.

Emphasis on Academic Topics Relative to Methods Topics

In response to the question concerning the weight given to various aspects of the curriculum, some students had this to say:

> And also the curriculum . . . it seems they put more emphasis on the academic work but I think methodology should be equally important. (Student L)

> . . . it seems that much emphasis is put on academic work than methodology. So a good time is spent on academic rather than methodology. That's according to me . . . the way I see it. (Student T)

Many students said that there was too much emphasis placed on academic aspects of the curriculum which to them was inappropriate. The reasons that students gave for the perceived emphasis were related to the structure of the examinations; that is, because examinations were theoretical and academically oriented, the teachers "delivered" materials that would be tested so that students can pass the examination.

In addition to the inappropriate emphasis, three

students also said that such an emphasis was a problem in that students may understand the subject matter and fail to present it to their students. A typical comment from student M is as follows:

> One problem with too much emphasis on academics is that one can be academically good but . . . without good command of methodology there is danger, . . . the danger for a teacher to show his advanced knowledge to students . . . instead of helping them learn the material at their level. (Student M)

While students perceived that there was too much emphasis on academic aspects, they, on the other hand, perceived a lack of enough emphasis on the methodology which according to them should be emphasized. Students R and S, with great concern, comment thus on emphasis:

> Actually I am saying that . . . we are taught very little methodology . . . and you find that the teachers do not pay much attention to methodology . . . but they write notes for us. (Student R)

> I think the weight given to methodology is not enough . . . because nowadays we are struggling to prepare students for the examinations. (Student S)

It appears therefore that students perceive the curriculum as placing too much emphasis on academic knowledge and not enough emphasis on methodology.

Relevance of the Curriculum

The majority of the students interviewed appeared to be satisfied with the content of the curriculum in general, and expressed some positive opinions regarding its

relevance to their preparation, although each student had a different criteria for judging relevance. Student R, for example, said that the curriculum was relevant because it included some topics and activities which can "enlighten" students on the work ahead of them. Student T said that the curriculum was relevant because it relates to the secondary school physics syllabus. On the other hand, student P said the curriculum was relevant because it could enable students to understand their environment better. Student S said that it was relevant because it could prepare him to "tackle" the work of teaching physics.

On the contrary, however, four students had some negative opinions regarding the relevance of the curriculum to their preparation, and to the Tanzanian situation in general. Student X, for example, said that he found the curriculum not useful because it is based on objectives which he finds to be unclear. His comment is as quoted below:

> Well, my view is that the physics content is not very clear . . . the aims, or why some topics are included . . . is not clear. And that is why I think the content may not be useful to me personally. (Student X)

Student N, on the other hand, felt that some topics in the curriculum are not of immediate application, and gave the example of a topic such as nuclear energy. Students J and Z felt that the topics were relevant in general but some details were not useful. They said that details presented in the topics of quantum physics and in electronics could

only be useful for people who are preparing to work in very technical fields.

It is evident from some of these comments that students find the curriculum generally relevant with a few areas or topics which may not be relevant to their immediate needs of teaching physics.

Instructional Methods

The second major area of discussion was centred around the topic of instructional methods. Students were asked to comment on the instructional methods used in the process of implementing the physics curriculum.

Lectures as a Teaching Strategy

Students overwhelmingly identified the lecture method as the most frequently used instructional procedure. Most important was the way they described their perceptions of the lectures that took place. For example, Student Y described his experience of attending lectures in the following way:

> Now you will find that the instructions are very theoretical. The teacher reads and comes and gives a lecture to us. It is very rare that we get to discuss . . . therefore the trend is to listen and you just take it. Mostly, I think you just have to cram most of the "material." (Student Y)

For him, lectures are reproductions of that which is read by the teacher to the class. The student at the receiving end

has to be passive, and in order to be able to reproduce it some later day, has to "cram" what is covered. For Student T, lectures are not effective:

> In lectures it is very simple to forget. When the teacher comes and gives a lecture, you will follow at the point when he is talking about it, but after a while you will forget everything . . . you cannot imagine . . . because you didn't see anything which corresponds or correlates to the knowledge you get and its application. (Student T)

Another student (Student P) described lectures as "spoon feeding" processes and that one can never get the real picture of things. Student M and Student Q described lecture method as one which does not involve the learners very much. To Student Z, lectures in physics were teacher dominated and students could ask questions only when given the chance.

The various descriptions that students gave reinforced the theme that lectures were perceived as not being very effective in that they did not involve the learner.

Other Methods of Instruction

Besides lectures, students also identified project method, experimental methods, micro-teaching and discussions as some of the other instructional procedures used, but less frequently. Student R and Student S, for example, described the project method as a very involving and interesting one and students get to learn a lot by themselves. Their comments included:

> What I like about the project method which was used is the idea of learning by ourselves . . . because then you get motivated, and it is interesting . . . like the way we were involved in our project to construct a simple instrument for conducting experiments in light . . . then this way you develop your own skills. (Student R)

> Yes . . . project method is good. Although sometimes it can take a long time. . . like ours took more than three months . . . but then we did something of our own plan, . . . it was not like lectures where you get all those "doses." (Student S)

When describing both experimental and project methods, students stressed that they became involved, and they found the learning process more meaningful to them than it was during lectures. Student X, on the other hand, was of the opinion that even the experimental method used was not very effective because it involved following experiments to repeat previously done experiments:

> You will find that the students are not given the chance to use the lab appropriately . . . because one is expected to repeat experiments which have been done by others . . . he is forced to . . . well, something like this . . . me personally I don't see it as a practical. (Student X)

To Student X, it appears therefore that a "hands on" experience for its own sake is not meaningful.

Concerning discussions and micro-teaching, students were of the opinion that these were used when methods topics were presented, and not as much with academic topics. Student L, for example, said that discussions were used after a lecture in a methods topic, and very often for a very short time or even after the class hour. Students also

identified micro-teaching as being used for a short period just prior to embarking on teaching practice. Despite this, students were of the opinion that discussions and micro-teaching procedures were very effective and that they should be used more frequently than had been the case.

Another description of the instructional methods was that they lacked some personal development on the part of the student, and were geared toward enabling the student to pass exams or for teaching only. A typical concern is as follows:

> And also concerning the teaching process . . . you will find that . . . when they teach us, they just try to explain . . . but the concept you get is that we are learning for the purpose of going to teach it only, and not for myself, . . . for me to be able to develop something. (Student X)

In general, therefore, the students perceive the instructions as involving a process of transmitting factual information on topics without much involvement on the part of the learner. Lectures were more frequent whereas other methods which were perceived to be more effective, such as project method, experimental method, micro-teaching, and discussions, were less frequently used.

Preparation for Teaching Practice

In order to explore students' perception of the preparation they had prior to their teaching practice, students were asked to describe the sort of things they were

prepared for and to express views about their preparation in general.

Lesson Preparation Skills

Students expressed some very positive comments about the usefulness of the preparation they received in connection with lesson preparation skills and schemes of work. Some of the comments included:

> Before going out for block teaching practice we were taught how to write on the board . . . also how to prepare lesson plans and schemes of work for physics . . . . Actually I think the preparation was fairly sufficient. (Student R)

> We were prepared well . . . because first we had methods of teaching physics, then we were taught how to prepare lessons, schemes of work . . . and also how you could teach in class . . . so I think we were well prepared. (Student S)

There was also a general view that construction of teaching aids and micro-teaching were very useful ways of preparing for the teaching practice. Nonetheless, it was significant that students found the time spent on these aspects of their preparation very short. The following comments from students P and L illustrate this:

> For the teaching practice I think they prepared us well . . . because we had some micro-teaching and single lesson practice, but only for a short time. If they could increase it, then it would be even better. (Student P)

> There was a short period of micro-teaching before going for block teaching practice. I suggest there should be a longer period of micro-teaching . . . because this is the

> only way you can learn how to present a lesson. (Student L)

There seemed to be agreement that micro-teaching was useful in that it helped students develop some skills in presenting lessons before going to the schools.

Preparation in Teaching Methods

Students expressed some common concerns about not having studied or tried out various physics teaching methods. They felt that it was important for them to have experimented with different methods before their teaching practice session.

As Student X commented:

> . . . but as I said before . . . concerning the methods of teaching, you will find that these methods are often not used . . . actually we just read about them but we don't know exactly when they can be used . . . and here we are expected to use various methods during our teaching practice.

Preparation for Conducting Practicals

Another concern regarding the preparation for teaching practice had to do with ability to handle the secondary school syllabus, particularly the practicals. Students were greatly concerned about the lack of practicals in the course and that failure to review some aspects of the secondary school syllabus led to their lack of confidence when they went out for teaching practice:

> Although it is [known] that experimentation is a good method of teaching, . . . we ourselves have been missing these skills, so much that when we get to the schools we lack the confidence to conduct experiments. (Student J)

> My suggestion about the preparation we get before teaching practice . . . it will be better if we could get some time to review the syllabus . . . and also go through some experiments in the syllabus. (Student N)

In summary, the students perceive the curriculum as preparing them well in lesson preparation skills and lesson presentation skills, but does not prepare them well in knowledge of various teaching methods, in skills to conduct experiments, and in understanding some areas of the secondary school syllabus.

Resources and Public Support

Discussions on resources and support were centred around two questions: What can be done by the college, students and teachers to alleviate the problem of a lack in facilities and equipment for teaching the course; and, What are your views and concerns about public support for science education in general?

Equipment and Facilities

There was a general concern from many students that colleges lacked adequate facilities, and that the existing equipment was not given much care. As such, students felt that colleges could accomplish much more if efforts were

made to maintain existing equipment. Students also said that some of the existing laboratory equipment was never put into use for a long time and therefore simply deteriorated. The following comment illustrates this:

> Some of the equipment in the lab is rotting there . . . yes, because I think they never get used. So I don't think even if they buy . . . new ones we can succeed . . . because they can get spoiled again unless they make use of it. (Student M)

Some students were also of the opinion that the problem of teaching aids and some equipment could be partly alleviated if students, with the help of teachers, worked together to construct some simple equipment. Two students indicated that there was little that could be done by students and teachers because of poor "workshop" facilities in colleges, since one needed some materials and some basic workshop equipment to construct even a very simple teaching aid. To elaborate this, Student S gave an example of how he had to go around the schools just to borrow some simple items for constructing equipment for his project.

> Yes, the problem was to get some of the items . . . and we went to so many schools just for some wires and to borrow some equipment . . . I think if our college had enough equipment then students could construct a number of teaching aids. (Student S)

In general, therefore, students sense that colleges (i.e. teachers and students) could partly help in alleviating the problem of equipment and facilities by putting into use and taking care of existing equipment, as well as constructing simple teaching aids.

Public Support

Concerning public support, students felt that the Ministry of Education was not putting enough consideration into providing science equipment, books, and other teaching/learning materials. A few students felt that this lack of consideration had to do with the poor economy of the country while others felt that the problem, to a large extent, had to do with poor planning and low priority for science equipment at the Ministry and national levels. To elaborate his concern further, Student L had the following to say:

> I think the Ministry of Education does not plan well . . . because . . . you will find that some of the secondary schools have the equipment, and the colleges are less equipped. I think priority should be given to training competent science teachers.

Another concern which was brought up during interviews was about the lack of sufficient and competent teachers for teaching the subject. To express his concern, Student M had the following to say:

> For me I am a bit disappointed . . . say by the way the Ministry of Education does not think about the importance of teachers for physics and science in general. For example . . . . if you look at the lack of enough teachers . . . and then the few who are there are overworked, and then they just rush things because they are overworked.

Another student said that there were not enough physics teachers, and those who joined the colleges stayed for a short period. Such a trend, he said, was common for a number of science teachers. When asked to explain why science teachers left after a short period, he said, "Maybe the

Ministry of Education does not treat them well . . . or does not pay them well."

In addition to the perceived problem of teachers and lack of facilities, students also expressed a great concern about financial support during the teaching practice session. Many of them felt that the allowance given was never enough for rent and food, and this created a lot of problems and lack of concentration in the teaching practice activities.

In general, therefore, students perceived a lack of sufficient financial support, lab equipment and other supplies, and enough competent teachers as adversely affecting the success of their training.

Assessment Procedures

Assessment procedures and the criteria used for determining successful students evoked many comments from students. This was brought about when students were asked to describe the procedures used in assessing their performance in physics. All students seemed to be fairly aware of the procedures and they identified three main areas of assessment, namely, continuous coursework assessment, teaching practice assessment, and final national examination.

Coursework Assessment

Most students expressed the view that continuous coursework assessment was a fairly reliable procedure of measuring students' achievements in the curriculum.

Students generally felt that continuous coursework assessment was useful in that through this method students could follow their own progress. Comments included:

> About assessment . . . I think assessment to daily performance . . . there is no problem. It is quite fair and reliable because we get back our papers and discuss our mistakes with the teacher. (Student P)

> For the coursework assessment I can say it is nice . . . because they mark our assignments and tests and we get the feedback. (Student Q)

> The coursework here is . . . is well done because we believe that those assignments we do are well marked and recorded by the physics teacher. (Student S)

Students also expressed some shortcomings about the coursework in physics. Some felt that the coursework could be more useful if teachers would give a variety and adequate number of assignments. As Student Z commented:

> Actually they assess us by giving exercises and tests which may be given each month, and end-of-term tests. Although this happens to be the procedure, . . . but the exercises are not adequate and more tests . . . because sometimes we stay for a long time without exercises.

Student P, on the other hand, described the assignments given as not very useful:

> The assignments given are not useful . . . may be if they could give . . . assign students to find something for themselves . . . that will give them some time to "dig" something out and learn about it . . . instead they only give problems and problems to solve. This way you cannot learn much physics.

Although many students conceded that coursework assessment was fairly useful and reliable, it had not in their view been given appropriate weight in the final

judgement of a student's grade. Several students expressed some doubts as to whether coursework marks were considered at all in determining the final grade. Their comments included:

> The continuous assessment is not all that bad, it is good, but one bad thing is that . . . this board of national examination seems to concentrate on the results of the final examination . . . I think that, perhaps, the "staff" of coursework assessment is just a cover-up . . . they don't consider it . . . . (Student T)

> I think the coursework is not considered in the final grade . . . because if this coursework is considered . . . then how does it come . . . so many students can get an "F" [failure] and you know that for their years in college they have been doing well in coursework? (Student Q)

On the negative side, however, three students expressed some negative feelings about the validity, reliability and usefulness of coursework assessment. Student X, for example, felt that coursework assessment was not a reliable measure of students' achievement because of the way tests and assignments are given:

> Concerning coursework assessment . . . actually here they give tests after every topic is covered. Now, this kind of assessment does not help the teacher to realize the ability of a student in physics . . . because a student can cram for the test . . . and even if he passes, the teacher will not really know his potentiality in physics . . . that's how I see it.

Student L also sensed that coursework assessment was not valid because it did not assess the attitude and the interest of the student in physics, which he felt was very important. His comment was:

> I think the coursework assessment is not very good because they don't assess students' attitude and interest in physics . . . this is important because for a teacher you need to consider his interest and attitude also.

It is evident from both the positive and negative comments about coursework assessment that students in general approve of the coursework procedure as a worthwhile means of assessing performance. What they perceive as shortcomings, however, are the low quality and quantity of exercises assigned, the reliability and validity of such exercises and tests, and the aspects that are left out in the assessment, such as interest and attitude. Also, students were very much concerned about the little weight given to the coursework in determining the final grade for which they were uncertain as to how the grade was determined.

Teaching Practice Assessment

Teaching practice assessment was another area in which students expressed a variety of concerns. Their major contention was the idea of non-physics teachers supervising a physics lesson. This is illustrated by Student L's comment as follows:

> And when we are assessed by a teacher who is not a physics teacher, then it is bad. . . it is bad because this teacher will not be able to help you when you make mistakes . . . or even when you don't know . . . when you can't set your experiment . . . then he cannot show you how to do it.

Student T also commented against this idea, as follows:

> But about the teaching practice assessment, there is some problem. You may be assessed . . . by a teacher who is teaching Kiswahili or English . . . . Now there will be some disadvantage . . . there must be . . . maybe he will assess those points which are written there (in the assessment form), but something about the knowledge of the subject . . . well he himself may not know physics . . . so if he doesn't know . . . your explanation sometimes may not convince him that you know physics . . . . This problem we do face, . . . it is there.

Another concern regarding teaching practice assessment had to do with the way teachers attended to it. Several students expressed the view that, some teachers never took the exercise seriously. Their major complaints were that some teachers completed the assessment in a rush, came late for a lesson, never stayed throughout a double-lesson, and sometimes never stayed for discussions with a student after completion of the lesson. Student J's comments illustrate this:

> Sometimes the tutors who assess teaching practice do not take the issue seriously. Some are in a rush . . . and they don't spend time to discuss the lesson with you.

Some students also expressed some dissatisfaction that a number of teachers did not agree on some lesson presentation procedures, and this posed some problems to them when they had to respond to conflicting advice on certain issues. Also, unfairness in assessment was identified as another source of weakness during some evaluations. Regarding this, Student L had this to say:

> Teachers sometimes do not agree on a teaching format that we should follow . . . and some

> teachers are not fair. If, for example, a teacher does not relate well with a student . . . then he takes this as an opportunity to penalize the student.

Despite the many complaints about the way that the teaching practice assessment is conducted, there was, in general, a feeling that teaching practice was the most important aspect of the curriculum and that teachers should concentrate more in supervising and providing necessary assistance to students.

Final Examinations

Discussions on examinations evoked many comments from students. There was a strong feeling that the final national examinations were a threat to teachers as well as to students themselves; and that much of that which is done in the course is to a great extent determined by the examinations. To express this concern, Student S had this to say:

> Because nowadays we are struggling to prepare a student for the examination instead of preparing him to be a good teacher . . . because we are afraid . . . because if you don't pass your examinations then you are going to lose your profession.

To explain the reasons for teachers' excessive emphasis on academic work, Student S continued:

> It means, then, . . . that a teacher who is teaching physics will be afraid of being blamed to give out poor results . . . so he will do his level best to make sure that the students pass . . . it means then he will put more emphasis on the academics.

It appears from this statement that to pass examinations, emphasis must be put on academic work. Students also described the examinations as being very theoretical, and that they do not measure student achievement in practical skills; rather, they measure their ability to recall knowledge. Several students expressed these views in various ways. Some of their comments included:

> But again, one thing is that the final examination is all theory. They don't test our practical skills. If for one thing . . . I would suggest that even the final exam should test practical skills. (Student K)

> The final exam is good . . . but the structure of the exam . . . they put emphasis on A-level academic work . . . I think it is better if the exam would put more emphasis on professional skills and the things that we shall be teaching in the schools. (Student Y)

Students also explained the lack of emphasis on practical work as a response to the threat and structure of examinations; since teachers had to pay attention to those things that are examined, they spend less or no time on practical work, because it is not examined. Student T illustrated this as follows:

> In our lab there seems to be a variety of equipment, but time to deal with it is really limited. If we could have time to use it then it could be a very good step forward. . . but our time . . . we are fighting for how we can pass the exams . . . so if you waste time with the equipment, then it will be your funeral.

It is for this reason that many students recommended final practical examinations in the hope that practicals will then be emphasized as well. A comment by Student P is a good example of this:

> Because in the final exam we have no practical work . . . so I think in colleges there are no practicals . . . because if there are practicals in the final exam then we will have to be prepared.

Besides the problem of structure and bias, in the examinations, students also questioned the validity and the reliability of the examinations. Student Q, for example, had the following to say:

> It happens that for the final exam, . . . the paper is based on certain few topics . . . so we can say that . . . actually the papers are not valid . . . or validity is fifty-fifty.

Student T also expressed a feeling that the examinations do not measure that which they purport to measure:

> Then the final examinations are nothing, it is not the best way to measure achievement. How can . . . I mean, a three-hour paper be used to decide one's work for two years? This cannot indicate . . . even passing the exam does not mean one has mastered the curriculum.

Another concern which was expressed by almost every student had to do with the weight given to the final examination in determining the overall performance of a student in the course. Student P, for example, said that "they" put too much weight on the results of the final examination although she, like many others, did not know for certain the exact weight given to the final examination grade in determining the final overall grade. She even doubted whether the coursework mark was considered in determining students' final grades. Student Q expressed some similar concerns as follows:

> Actually I don't know . . . I am not sure. But I think the coursework is not considered . . . so it is better for them to tell us . . . whether the coursework is considered or not . . . than being treated like kids.

Similar doubts were expressed by Student S. His reasoning was that since a number of students in the previous years who had performed well in their coursework were declared failures after their exam results, it was very likely that the coursework performance was not considered. His comments were as follows:

> I don't see how a person could have failed flat while he did well in his coursework . . . unless these people never considered the coursework . . . . . This means the exam council don't follow what they say . . . that is, coursework and the final exam are taken into some ratio to give the final grade.

For Student P and Student T the emphasis on final examinations was an intended move to select a few students and not a measure of competence. Their comments were as follows:

> These people give too much weight to the final exam . . . maybe . . . maybe because they want to select only a few. (Student P)

> . . . so I think to try and concentrate on just the final examination is not good . . . I know the problem . . . perhaps is to do with selection. If they are doing this because they have set some limited places . . . you see . . . even if many will pass . . . some will be reserved. (Student T)

In summary, students perceive the final examination as determining the implementation of the curriculum. Students also perceive the structure of the examination as being inappropriate as it concentrates on the academic and theoretical aspects of the curriculum. In addition,

students perceive the exams as being given too much weight at the expense of disregarding coursework performance.

Comments and Suggestions

Toward the end of each interview, students were invited to give their general comments and suggestions about the physics curriculum. Upon analyzing the interview responses, six outstanding categories of comments and suggestions were identified, as follows:

1. Curriculum and Instruction. Students suggested that the curriculum should emphasize practicals and aim at developing some creativity among students. Students also suggested that teachers should use a variety of teaching methods and stress assignments for students which are more involving than the case has been.
2. Assessment Procedures. Nearly all the students who were interviewed suggested the inclusion of practical examinations at the end of the program. Many students also suggested the reduction of weight given to the final examinations and more weight for the coursework assessment, and that students should be informed of the contribution of each aspect of the assessment toward the final grade. One student suggested that physics teachers should have the major say in deciding students' success or failure and not the national examination council. Another student suggested that examinations should be given at the end of each unit in the course

instead of one national examination at the end of the course.

3. Teachers. Students commented that some teachers for the course were not competent, and suggested that the Ministry should make an effort to ensure that competent teachers are made available to train competent physics teachers.

4. Resources. Students suggested that the Ministry of Education should ensure availability of reading materials and laboratory equipment for the physics course.

5. Financial Conditions. Students suggested very strongly that there was need for the Ministry of Education to increase the financial allowance given during teaching practice sessions since this affected their teaching experience to a great extent.

6. Time. Students suggested that the time for teaching practice should be increased so that they could have more time to teach at least one major unit in a given class. Also, students in the three-year "high school" pre-service program suggested that the time for the course should be increased to at least three and a half years instead of three years.

Summary of Key Themes from Interview Responses

The following section summarizes the key themes in terms of students' perception of the physics curriculum as derived from interview responses. It is important to bear in mind that in expressing their views, students made no distinction between the curriculum as planned and the curriculum as translated in their classes.

Curriculum Content and Organization

1. Students perceive the curriculum as being very theoretical with little or no practical application.
2. Students find the curriculum lacking adequate "hands on" experience or experimental skills.
3. Students generally perceive the content of the curriculum as not being difficult and that the difficulty in a few topics is due to the use of theoretical and mathematical approach in presenting them, and also due to a lack of sufficient background in high school physics.
4. Students perceive the curriculum as placing excessive emphasis on academic knowledge and not enough emphasis on studying methods topics.
5. Students perceive the content included in the curriculum and more so the methods topics as being generally relevant to their preparation with only a few details in some topics such as quantum theory and electronics which may not be relevant to their immediate needs as teachers.

Instructional Methods

6. Students perceive the instruction as involving a process of transmitting factual information mainly through lectures without much involvement on their part.
7. Students perceive the project method, experiments, microteaching and discussions as more effective than lectures. They observe that these methods are used less frequently than lectures.

Teaching Practice Preparation

8. Students perceive the curriculum as preparing them well in lesson preparation and presentation skills but not as well in various methods of teaching, in conducting experiments and in handling some areas in the secondary school physics syllabus.

Resources and Public Support

9. Students perceive lack of sufficient support by the Ministry of Education in alleviating the problem of equipment and facilities, and that colleges, teachers and students can contribute in some small ways to alleviate this problem by mainly making good use of existing equipment and constructing some simple teaching aids.

Assessment Procedures

10. Students perceive the continuous coursework assessment procedure as a good one and feel that it is not given enough recognition/weight in determining a student's final grade.
11. Students perceive the teaching practice as the most important experience in the program, and feel that the development of effective supervision has not received the attention it deserves from the teachers.
12. Students perceive the final examination as the determining factor in the implementation of the curriculum, as being too theoretical, and that the great emphasis/weight assigned to it at the expense of other areas of performance is threatening and inappropriate and encouraged cramming.

Suggestions

13. Students suggested that the curriculum should emphasize practicals and even include practical exams.
14. Students suggested that coursework assessment should be of greater importance in determining the students' final grade, than the final examination.
15. Students suggested that every effort should be made to have enough competent teachers, adequate facilities and equipment, and improved financial conditions during teaching practice sessions.

16. Students suggested that time for teaching practice should be increased, and course time for the three-year program should be increased to at least three and a half years.
17. Students suggested that teachers should be more involved and more serious in supervising students during the teaching practice session.
18. Students suggested that the curriculum should encourage a variety of methods of instruction, other than lectures, and should encourage creativity among students.

CHAPTER VII

DISCUSSION, IMPLICATIONS, CONCLUSIONS

This chapter is divided into five sections. In section one, the major findings are discussed by focusing them to the research questions as well as to some findings of previous studies which were reviewed in Chapter III. Section two summarizes the limitations and strengths of the methods employed. The implications and recommendations arising from the findings are presented in sections three and four, respectively. Section five, entitled "Reflections," is written from the personal perspective of the researcher and describes some of the problems which were encountered in planning and implementing the study.

Discussions of Findings

The first research question sought for the meanings that the curriculum has for the students. An examination of the responses and of the themes that emerged from both interviews and questionnaire responses indicate that students interpret the curriculum as being all those activities that are carried out during a physics lesson between themselves and their teachers, including the subject matter that is dealt with and the teaching/learning processes. There

was only one student who made a specific distinction between the curriculum as intended and the curriculum as implemented.

Understanding students' interpretations of the curriculum is very crucial to this study, since all other findings can be understood by realizing that which students were referring to when giving their views, opinions and suggestions about the curriculum. Failure to relate the findings to the meaning that students attach to the curriculum may render some of their views, concerns and suggestions meaningless and hence useless. For the students, the curriculum as planned or as intended is "unknown," rather, that which is translated and interpreted in their classes is what they know of and comment on; this may not necessarily be similar to, or close to, the planned curriculum.

It is also important to note at this point that some items on the questionnaire, and particularly those with controlled-type responses, referred to some aspects of the "planned" curriculum. Interviews, on the other hand, encouraged students to talk about the curriculum as they themselves understood it. No mention of the "planned" curriculum was brought into discussion by the interviewer.

Research question two sought for students' perceptions of that which constitutes the curriculum. Students' views, opinions and concerns about the subject matter, its organization and emphasis, difficulty, and instructional

procedures seem to have provided some answers to this question. Concerning subject matter, findings from interviews as well as from the questionnaire indicate that the students perceive the curriculum as consisting of very theoretical-factual knowledge with no "hands on" experience or practical application. Students also perceive the curriculum as being very academically oriented with a great deal of emphasis being placed on academic topics. Similar findings concerning some teacher education programs being theoretical and emphasizing knowledge of content were reported in other studies reviewed, and in particular by Marr (1973) in Punjab, and Ratsoy et al. (1979) at the University of Alberta.

Concerning difficulty, findings from interviews indicate that many topics covered are not considered difficult and that the difficulty encountered in a few topics was due to the theoretical and mathematical approach in presentation. There was, however, a slightly different opinion from questionnaire responses, whereby students rated the academic topics as being fairly or very difficult and methods topics as of little or no difficulty. This dichotomy should not be surprising when we consider the two approaches which led to these findings. As explained earlier, during interviews, students were encouraged to talk about the curriculum as they themselves understood it, whereas in the questionnaire students were presented with topics as they appear in the planned curriculum and asked

to rate the difficulty using a fixed scale. The scale could have been interpreted in various ways. It is also possible that the scale may have limited other responses which do not fall within the range provided. Also, some topics may not have been covered in their classes. In other words, the variation in responses shows the fundamental difference between interviews and questionnaires in eliciting people's opinions. Interview responses in this case may have provided a situational interpretation of the difficulty, whereas questionnaire responses, on the other hand, may have provided a very general view of the difficulty of the topics listed and not necessarily as experienced.

Students generally found lectures to have been the dominant instructional method, and indicated that lectures were less interesting and less effective than the less frequently used methods of experimentation, discussion and projects. The findings that lectures dominate instructional procedures were also reported in the studies conducted by Marr (1973) in India, Ratsoy et al. (1979) in Canada, and Bethel (1981) in the Bahamas. It is important to note here that, although field trips were not mentioned in the interviews as one of the methods used in instructions, it was nonetheless assessed in the questionnaire as one of the very effective methods of instruction. One possible explanation is that students were assessing this method not necessarily from college experience, but from their previous knowledge or experience in secondary schools.

Another possibility is that this instructional method may have been discussed theoretically in their lessons.

The third research question sought for students' perception of the curriculum as regarding its relevance in their preparation to become physics teachers. Generally, students perceive all the topics in the curriculum, and more so the methods topics, to be relevant to their preparation. As the respondents in the study conducted by Bethel (1981) in the Bahamas, students rated the methods topics as being more relevant than the academic topics. Similarly, responses in the interviews indicate that students judged the methods topics to be more relevant than academic topics.

The fourth research question sought for strengths and weaknesses of the curriculum as perceived by the students. Findings from the interviews and the questionnaire indicate that students perceive the curriculum to have been strongest in providing them with skills in lesson preparation, lesson presentation, and classroom management. Students also find continuous coursework assessment and teaching practice assessment as important criteria for assessing their performance in the program, and that the criteria used for assessing teaching practice performance is well founded. Bethel (1981) reported similar findings about strengths of teacher education programs in the Bahamas.

Despite the perceived strengths, the curriculum is also perceived to have been weak in various aspects. According to the students, the curriculum does not offer a

"hands on" experience or, in other words, experience-based learning whereby theory is integrated with direct experience such as practical work in the laboratory, skills to conduct experiments, demonstrations, excursions, and visits. The curriculum is also perceived to have failed to provide enough knowledge and skills on various methods of teaching. Like respondents in the study conducted by Marr (1973) in India, and that reported by Skilton (1978) in Australia, students find the curriculum to have been very weak in providing them with adequate and informed teaching practice supervision.

Findings that the external final examination is a major weakness of the curriculum confirm similar findings reported by Haque (1977) and Marr (1973). The students' major contention was that the examinations are very theoretical, testing factual knowledge and, as a result, encouraging cramming. Students also expressed some concerns about the excessive weight (50%) assigned to the final examination. The complaint that the structure and the emphasis of the examination determine to a large extent that which is taught and emphasized in the class is similar to the complaints that respondents expressed in Marr's (1973) study. This reliance on final examinations seems to be common in developing countries, and African countries in particular. Regarding this, Yoloye (cited in Wheeler, 1967, p. 110) had this to say:

> . . . because of the set up in many African countries, the procedures for evaluating student achievement often play a more significant role in determining what is taught in schools than the curriculum.

The findings that colleges lack adequate facilities and other teaching/learning materials reflects a chronic problem reported in other studies conducted in developing countries (Marr, 1973; Haque, 1977; Bethel, 1981). Colleges in this study are also perceived to lack enough qualified teachers, and teachers who are motivated and interested in the subject. Such unfavourable intellectual climates were also reported by Marr (1973), Haque (1977) and Skilton (1978).

The last research question sought students' suggestions for alleviating perceived problems of the curriculum. The various suggestions identified from the findings are as follows:

1. The curriculum should place more emphasis on practicals, and methods topics, particularly micro-teaching, syllabus analysis, teaching methods, nature of physics, laboratory management, and teaching aids.
2. The curriculum should emphasize various instructional methods that involve the learner, such as projects, discussions, experiments and field trips.
3. The final examination should include practicals and it should be given less weight allowing for more weight from coursework and teaching practice performance.
4. Effort should be made to have an adequate number of competent teachers as well as adequate resources.

5. Teaching practice supervision should be conducted by science teachers. Other teachers should supervise physics only if they understand the subject. Teachers should spend enough time with students to provide advice.
6. The time for the three-year program should be increased so as to incorporate two sessions of teaching practice as in the two-year program.
7. The living conditions in colleges should be improved.
8. Financial assistance during teaching practice should be increased.

Summary and Conclusions

The description of this study has presented students' perceptions and interpretations of the physics curriculum. It has also summarized their view of that which it constitutes, its relevance to their training, its strengths and weaknesses, and their suggestions on how problems experienced in implementing the curriculum may be alleviated. A review of previous studies have indicated how students' perceptions can determine the success or failure of a curriculum. A review of methodologies employed in curriculum studies and evaluation studies in general led to the choice of both situational interpretive approach and empirical analytic approach as suitable frameworks from which to conduct the study.

Data consisting of students' views, opinions and concerns were collected by means of semi-structured

interviews and a questionnaire constructed by the researcher. Interviews were audio-recorded, transcribed and interpreted by the researcher. The interpretations were then validated by the interviewees. Other field notes, classroom observations and still photographs were compiled to help in understanding some of the classroom and college situations.

Participants were delimited to students in the final year of their teacher education diploma program. This may have a significant limitation on the generalizability of the findings.

The questionnaire was scritunized for face validity and content validity. It was also pilot tested with five students in one of the three colleges involved in the study. This testing, however, was not extensive enough to cover the three institutional variations.

Findings from the interviews were derived totally from the respondents' views, opinions and concerns, and this depended to a large extent on the degree to which they were willing to express themselves with sincerity. However, the idea of interviewing students who had already responded to the questionnaire may have influenced the type of information gathered during interviews even though the questions dealt with were different. The fact that interviewees validated the interpretations that were made from the interviews, on the other hand, adds to the strength of the validity of the findings.

Given the foregoing limitations, there are some indications from the findings that students' perceptions can be uncovered through the methods used. The fact that most information gathered through interviews was to a great extent consistent among interviewees indicates some stability in the views given. The emergence of categories from the responses for open-ended questionnaire items which were similar to some themes identified from interview responses indicates the reliability of the instruments and validity of questions asked. It is also evident from the findings that familiarity to the context and the situations from which students were raising their concerns and views was vital to the act of interpreting both interview and questionnaire responses. It is evident from the discussions that some questionnaire responses alone could have been interpreted out of context, if it were not for the information from interviews.

Implications

What can the knowledge of students' perceptions of the physics curriculum arrived at from this study tell us about the curriculum itself and about the training of physics teachers in general? Turning to the meaning that the curriculum has for the students, we find that they refer to that which is translated in their physics lessons as the curriculum. This would suggest that the curriculum as

"intended" may have little or no meaning to students. This knowledge may have several implications for curriculum development and evaluation, in that however well we may plan a curriculum, what is of significance to students is that which is actually translated and interpreted in their classes. At the same time, this tells us of the importance of distinguishing the two when conducting evaluation studies.

The curriculum is perceived by students to be emphasizing academic content as opposed to students' recommendation for emphasis on methods topics. This would suggest that students may have priorities and needs which are different from those provided by the present curriculum. This knowledge may have influence on the views of those who are involved in planning and implementing the curriculum, that efforts may be more meaningful if a closer understanding of students' needs from their own perspectives is taken into consideration.

Turning to the students' major concerns, we find that lack of "hands on" experience is mentioned as one of the major weaknesses of the curriculum although experiments and other activities are highly recommended throughout the intended curriculum. This would suggest that the curriculum as presently presented is highly divorced from the curriculum as intended. There may be many explanations to this: one possible explanation is that the intended curriculum is unrealistic in relation to the intellectual and physical climates in the colleges.

One other major concern raised by the students was about the final national examinations. Their complaints included concerns about the nature of the exams, the validity and reliability of the exams, and the weight given to the exams toward their final grade. This would suggest that students performance as presently evaluated needs to be examined further.

Recommendations

The present study's findings have proven relevant to a better understanding of students' perceptions of the physics curriculum. In order to further our understanding, further studies could be attempted. First, this study could be replicated with first-year students and with graduates of the program. Generalizability of the present study's findings could be assessed by such research. Second, research on teachers' perceptions of the curriculum and the perceptions of other people involved in planning and implementing the curriculum could be conducted. Third, a study of the actual activities that take place in classroom situations and how teachers and students interpret such activities could be carried out. Findings from such a study will further our understanding of how curriculum is translated into actual classroom teaching/learning activities.

Reflections

At the beginning of my graduate program, I had the idea of doing some kind of a curriculum evaluation research for my thesis. This had been my aspiration since 1978 when I started being involved in curriculum development activities in Tanzania.

The courses that were suggested for me at the beginning of my program sounded ideal for my kind of preparation. First, there was the research design and statistics course which coincided with my expectations. The idea of generating hypotheses, testing significancies, and the use of computers to efficiently process massive data was not only exciting, it was in congruence to my idea of a rational researcher. Second were the science courses which I found useful in providing the kind of enlightenment I required on science education. The other courses were on curriculum development and evaluation. Judging from the title of the courses I expected to learn some "techniques" of curriculum evaluation which I most needed. To my surprise, I ended up learning about curriculum theorizing and discussing some conflicting conceptions of curriculum development and evaluation. This course must have been meant for people who like to theorize, I thought; I wasn't that kind of person, and it was not my intention to theorize about curriculum. Toward the end of the courses, some ideas which were presented started making sense to me. I think

this must have been the beginning of my acquiring another perpsective to my conception of curriculum evaluation, and more so when I read the works of Aoki (1978), Eisner (1979), and Werner (1979) on curriculum evaluation.

Gradually, as my graduate work progressed, the readings and the other courses I took added insights to my conception of curriculum evaluation. It became apparent that understanding participants' perceptions of a curriculum may be potentially significant and meaningful. I then decided to settle on the topic of students' perceptions of the physics curriculum for the diploma teacher preparation program in Tanzania.

My second concern was to state very precisely the problem of my study. This took a long period of reflection upon some concerns which had been expressed by students in the physics classes that I had taught. I experienced considerable stress in trying to dismiss the idea of generating hypotheses. Although I had participated in developing the curriculum and had taught it for two and a half years, I could not claim a clearly developed position as regarding students' perceptions of it. What I wanted, however, was to explore and reveal such perceptions. As I went on reading the literature, I found myself refining the problem statement further. By this time I was so convinced about the problem of my study that I started maintaining a log of my readings, my reflections and my plans. I also started to make inquiries about the possibilities of conducting the

study at Dar-es-Salaam College.

To answer my research questions, I felt that I needed some data consisting of students' views and opinions about the curriculum; but I was not sure of the methods to use in obtaining such data. The course on research methods in education could not have been scheduled at a better time for me. The readings and the discussions in the course provided some directions for methods and techniques of data collection. I then decided upon using a questionnaire and interviews as major methods of obtaining data.

As I went on developing the proposal, questionnaire construction and scheduling research activities became the most demanding activity. During this time I had to communicate with appropriate authorities in Tanzania to gain permission to do the research and meet other requirements. On presenting the proposal, I found the reactions and suggestions from my professors and my colleagues extremely useful in revising the questionnaire.

The process of obtaining research permission in Tanzania can be long and demanding, and especially when the proposal is from an institution outside the country. The follow-up of my letters and supporting documents by the principal of Dar-es-Salaam College speeded up the process.

One of the major stresses I experienced after gaining access to the colleges was the re-scheduling of my activities. Some of the students with whom I had planned to work during the first weeks of the research had been

scheduled for teaching practice. Final national examinations were also scheduled a bit earlier than I had anticipated. This shortened the period of time which was available for working with the students. The fact that I was accepted by teachers and principals of the three colleges as a colleague created a very favourable research environment. My honest explanation of the purpose and the utility of the research findings led to my being accepted by the students as a trustworthy individual. I could detect this kind of trust during the interview sessions and even during casual conversations with students.

The most demanding but exciting part of the research was the interviewing. Students were very eager to discuss their experiences and concerns. I found myself requiring eight to ten hours to transcribe one interview. The interpretations became faster and easier as I progressed. Once I tried to interpret an interview straight from the audio-recording, but this did not prove to be more efficient than from transcripts. At one time I felt as if I needed to cut down the number of interviews, but as the validation sessions required less time, I managed to conduct all the interviews as I had planned.

My other concern became perceptible as I started writing the thesis. I was concerned about presenting students' views in their own perspective as much as possible, as well as maintaining their anonymity. As a result, I found the writing of the chapter on interview findings taking more

time but becoming more satisfying than any other chapter. I felt as if I had been honest in letting know that which was of paramount concern to the students.

In ending my thesis report, I would like to make a few suggestions to my fellow Tanzanians, and, perhaps, those from other developing countries who may wish to pursue a similar path to mine. First, it is important to identify a research area/question that addresses the problems of education within our countries; possibly before leaving the country. In this way one will be able to obtain some relevant literature while in the country, and reduce a lot of frustrations encountered in trying to get such information posted away from home countries. It will also overcome the temptation of choosing research questions which may not necessarily be of significance to our own country. Second, it is important to be able to explain clearly the research problem as one will be bound to seek advice from people who may not be familiar to one's system of education. This will be necessary if one has to best benefit from the expertise and the abundant research resources available in a western institution. The urgent need to upgrade the national level of education in our countries, combined with the limited financial and material resources, make it imperative that every one of us use every educational opportunity to the maximum.

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APPENDIX A

AN OUTLINE OF THE PHYSICS CURRICULUM GUIDE

APPENDIX A

AN OUTLINE OF THE PHYSICS CURRICULUM GUIDE

Introduction

This Syllabus aims at producing teachers who are capable of teaching physics in forms 1 to 4 Tanzanian Secondary Schools. To achieve this, the Academic part of the syllabus lays more emphasis on materials studied in Secondary Schools so that students are given the opportunity to cover in detail certain topics which usually prove to be difficult to pupils in Secondary Schools.

The course encourages students to perform as many experiments as possible so that they become familiar with most of the physics equipment found in normal secondary school laboratories. Experiments for which there is not enough equipment to be given to each student in the class, tutors are advised to allow students to work in groups but it has to be observed that the resulting data are processed independently.

The shortage of physics teaching equipment in secondary schools is a well known problem and therefore students should be involved in the construction of low-cost laboratory equipment using the available local materials whenever possible. The course also encourages field trips and excursions to nearby places of scientific interest. It is hoped that tutors will make arrangements with authorities concerned (i.e. Heads of Parastatal Organizations) so that their students can visit such places.

Lastly, it is hoped that at the end of this course the students should be able to:

1. Acquire a useful command of physics concepts and principles;

2. Explain the physical realities within their immediate environment;

3. Achieve a professional competence in imparting the relevant knowledge and skills so acquired to form 1-to-4 pupils.

4. Use effective techniques of teaching physics; and

5. Recognize and appreciate that physics knowledge is a tool for technological development.

Topics

Part One: Methods

1. Aims of Teaching Physics
2. Physics Curriculum Development
3. Physics Teaching Methods
4. Physics Teaching Preparation (lesson plans and schemes of work)
5. Physics Teaching Aids
6. Projects and Field Trips
7. Assessment Methods and Techniques
8. Laboratory Management
9. Micro-teaching and Analysis of Secondary School Physics Syllabus

Part Two: Academic

1. Measurements
2. Vector Analysis
3. Forces
4. Energy
5. Motion
6. Wave Theory
7. Quantum Theory
8. Electro-magnetic Induction
9. A.C. Circuits
10. Structure of Matter
11. The Earth (Structure & Origin)

NB: For every topic listed above, there is a list of several behavioral objectives that should be achieved. There is also a list of suggested activities, experiments, projects, and field trips for each topic.

Suggested Teaching Methods

1. Discussions
2. Experimentation
3. Demonstration
4. Field Trips
5. Projects
6. Lectures

APPENDIX B

QUESTIONNAIRE ON STUDENT PERCEPTION OF THE PHYSICS CURRICULUM FOR THE DIPLOMA TEACHER EDUCATION PROGRAM

APPENDIX B

QUESTIONNAIRE ON STUDENT PERCEPTION OF THE PHYSICS CURRICULUM FOR THE DIPLOMA TEACHER EDUCATION PROGRAM

This questionnaire is designed to obtain your views and opinions about the physics curriculum for the diploma teacher education program.

This information will be useful in developing awareness and understanding of student teacher's concerns and views amongst those involved in the program.

You are invited to participate in the study by completing this questionnaire. You are encouraged to be frank and forthright in making your responses and are assured that all returns will be treated confidentially.

PLEASE NOTE that writing your name on the booklet is optional.

PART I: BACKGROUND INFORMATION

Please check (✓) the category which applies to you.

1. What is your age?

less than 20 years	( )
20-25 years	( )
above 25 years	( )

2. What is your sex?

male	( )
female	( )

3. Level of education?

Direct form six	( )
Direct form four	( )
Form four & private tuition	( )
Std. eight/seven & private tuition	( )
Other (please specify)	_____

4. What is your second teaching subject (other than physics) that you are studying?

mathematics	( )
chemistry	( )
biology	( )
other (please specify)	_____

5. Which of the following subjects did you study at high school level?

physics	( )
mathematics	( )
chemistry	( )
biology	( )
engineering science	( )
other (please specify)	_____

6. What is the grade at which you did most of your practice teaching?

form one	( )
form two	( )
form three	( )
form four	( )
other (please specify)	_____

7. Is there a science club or a science related 'self-reliance' project at your college?

yes	( )
no	( )

8. If yes, are you a member of any of the above mentioned club(s)/projects?

yes	( )
no	( )

9. If no, how do science students come together and exchange ideas at your college? _____

_____

PART II: PERSONAL INTEREST

Please circle <u>one</u> appropriate number for each question.

10. Did you have a desire to study and teach physics when you joined the teacher education program?

strongly desired	1
desired	2
had no desire	3

11. Do you find learning physics enjoyable?

very enjoyable	1
enjoyable	2
not enjoyable	3

12. How much of your out-of-class time do you spend on studying physics?

a great deal of my time	1
some of the time	2
hardly any of the time	3

13. How has your interest in physics or the teaching of physics been affected since joining the teacher education program?

interest increased	1
interest decreased	2
no effect	3

14. Which of the following levels of secondary school would you prefer to teach physics?

form one	1
form two	2
form three	3
form four	4

Why? _____

_____

15. What type of school would you prefer to teach physics?

girls' school	1
boys' school	2
co-educational school	3
other (please specify) _____	

PART III: CURRICULUM AND INSTRUCTION

Questions on this part refer to components of the physics curriculum and instruction. It is understood that you may not have covered some of the topic areas. If for this reason or any other reason you have no opinion about the questions which follow, please circle 0 as shown on the given scale.

16. Please rate the relevance, difficulty and interest you find in each of the listed topic areas in your preparation to be a physics teacher, using the scale given below.

scale: 1 - very relevant/difficult/interesting
2 - fairly relevant/difficult/interesting
3 - of little relevance/difficulty/interest
4 - not relevant/difficult/interesting
0 - no opinion

Circle one no. for each topic and for each aspect

	Relevance	Difficulty	Interest
Topics on Methods			
a. Nature of physics	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
b. Aims of teaching physics	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
c. Physics curriculum development	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
d. Physics teaching methods	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0

		Relevance	Difficulty	Interest
e.	Physics teaching preparation (lesson plans and schemes of work)	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
f.	Physics teaching aids	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
g.	Projects and field trips	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
h.	Assessment methods and techniques	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
i.	Laboratory management	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
j.	Micro-teaching and analysis of secondary school syllabus	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
	Topics on Academics			
k.	Measurements	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
l.	Vector analysis	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
m.	Forces	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
n.	Energy	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
o.	Motion	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
p.	Wave theory	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
q.	Quantum theory	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
r.	Electro-magnetic induction	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
s.	A.C. Circuits	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
t.	Structure of matter	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
u.	The earth	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0

17. Are there some topic areas (from the list in question 16) which seem to have been emphasized most? Please list the topics.

_____

_____

_____

_____

18. Are there some areas (from the list in question 16) which you would recommend for more emphasis? Please list the topics.

_____

_____

_____

_____

19. Are there some topics which do not appear in the list in question 16 which you think should be added to the physics curriculum? Please list the topics.

_____

_____

_____

_____

20. Some of the methods of instruction listed below may have been used in the process of helping you understand the physics curriclum. Please rate the effectiveness, adequacy and the interest you find in each of the methods.

scale: 1 - very effective/adequate/interesting
2 - fairly effective/adequate/interesting
3 - fairly ineffective/inadequate/uninteresting
4 - completely ineffective/inadequate/uninteresting
5 - no opinion

Circle one no. for each method and for each aspect

	Effectiveness	Adequacy	Interest
a. Discussions	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
b. Lectures	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
c. Experiments	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
d. Demonstrations	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
e. Projects	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0
f. Field trips	1 2 3 4 0	1 2 3 4 0	1 2 3 4 0

21. Please give an assessment of the time allocated to cover the physics curriculum.

	(circle one)
not sufficient time	1
just sufficient time	2
more than sufficient time	3

22. If your assessment for no. 19 above is that the time is not sufficient, how much time would you allocate for physics (in hours per week)? Please explain.

_____

_____

_____

_____

23. What are your comments about the assessment of student teachers' performances in the physics program?

_____

_____

_____

_____

24. What other general comments do you have concerning the physics curriculum and instruction?

_____

_____

_____

_____

_____

PART IV: TEACHING PRACTICE

25. (a) How long was your practice teaching in total? (Approximate number of weeks)

_____

(b) How many weeks did you actually teach?

_____

26. How well were you prepared in each of the areas listed below before your practice teaching experience?

		(Circle one)			
		Excellent	Good	Satisfactory	Poor
a.	Knowledge of the physics content that you taught	1	2	3	4
b.	Knowledge of physics teaching methods	1	2	3	4
c.	Instructional skill (e.g. presenting lessons)	1	2	3	4

		Excellent	Good	Satisfactory	Poor
d.	Preparation skills (e.g. lesson preparation)	1	2	3	4
e.	Skills in conducting experiments/demonstrations	1	2	3	4
f.	Skills in classroom management and organization	1	2	3	4
g.	Assessing students' performance	1	2	3	4

27. How many times in total were you supervised in the last session of your practice teaching?

_____

28. Did you find this number of supervision sessions sufficient?

(Circle One)

not sufficient	1
just sufficient	2
more than sufficient	3

29. If you found the number of supervision sessions 'not sufficient', how many times would you have liked to be supervised during the whole session?

_____

_____

_____

30. Did you find the supervision sessions useful?

(Circle one)

very useful	1
fairly useful	2
not useful	3

31. How confident do you feel to teach physics now?

(Circle one)

very confident	1
fairly confident	2
not confident	3

32. What outstanding problems did you encounter in teaching physics during your practice teaching? Please explain.

33. How was your performance in physics practice teaching assessed?

34. In your opinion, what should be the criteria for assessing your practice teaching?

35. In your opinion, how can your college/department of physics better help students prepare for their physics practice teaching?

PART V: RESOURCES AND OTHER SUPPORT

36. Please make an assessment of the physics teaching/learning resources listed below as you observe the state of affairs in your college.

(Circle one for each aspect)

		Completely adequate	Fairly adequate	Fairly inadequate	Completely inadequate
a.	Space in the laboratory	1	2	3	4
b.	Laboratory equipment	1	2	3	4
c.	Physics textbooks	1	2	3	4
d.	Other physics books and references	1	2	3	4

37. Do you recognize some effort being made to ensure that facilities/ equipment are available for the physics course? Please explain.

_____

_____

_____

_____

38. What suggestions do you have about alleviating problems of facilities/ equipment for the physics course?

_____

_____

_____

_____

39. (a) How important is science considered to be, relative to other subjects in the teacher education program by the various groups of people listed below?

(Circle one for each aspect)

		More important	Equally important	Less important	Don't know
a.	Educational policy makers and administrators	1	2	3	0
b.	Political leaders	1	2	3	0
c.	The community	1	2	3	0

(b) How is such importance reflected in practice? (e.g. time allocated to science subjects, salaries, etc.)?

_____

_____

_____

_____

PART VI: GENERAL

40. In general, how would you rate the success of your preparation to be a physics teacher?

(Circle one)

very successful	1
fairly successful	2
not successful	3

Please explain further.

_____

_____

_____

_____

41. In your opinion, how can the course be improved?

_____

_____

_____

_____

_____

_____

42. What other comments do you have regarding the preparatoin of diploma physics teachers?

43. What comments do you have about the questionnaire which you have just completed?

There is a plan to gather more information about students' concerns and opinions on the physics course through interviews. Those to be interviewed will be volunteers only, as such there is need to get an idea of the proportion of those volunteers. Would you be willing to participate in the interviews if contacted?

Yes ( ) No ( )

THANK YOU VERY MUCH FOR YOUR COOPERATION IN COMPLETING THIS QUESTIONNAIRE.

APPENDIX C

INTERVIEW GUIDELINE ON STUDENT PERCEPTIONS OF THE PHYSICS CURRICULUM

APPENDIX C

INTERVIEW GUIDELINE ON STUDENT PERCEPTIONS OF THE PHYSICS CURRICULUM

1. What are your views about the physics curriculum?
2. What do you think about the time/weight given to various aspects of the curriculum?
3. Do you find the subject matter easy/difficult to understand?
4. What makes it easy/difficult? Could you describe the kind of difficulty (if any) experienced?
5. Do you find the curriculum relevant to your preparation? What makes it relevant?
6. What are your views about the instructions?
7. Do you find the methods of instruction effective? What makes them effective? (or ineffective?)
8. Describe the sort of things you were prepared for before your teaching practice session.
9. What are your views about the preparation?
10. Describe the procedures used in assessing students' performance. What are your views about the procedures?
11. What are your concerns about resources available for the physics curriculum? How can problems be alleviated?
12. What other comments/suggestions do you have about the physics curriculum?

INTERVIEW SCHEDULE
(March-May 1985)

Student Identification	Subject Combination	Date & Time
J	Physics/ Biology	15 Mar. 3:30-4:45 p.m. 16 Mar. 8:15-8:30 p.m. 18 Mar. 3:30-4:10 p.m.
K	Physics/ Mathematics	20 Mar. 4:00-5:20 p.m. 22 Mar. 4:00-4:45 p.m.
L	Physics/ Chemistry	23 Mar. 4:00-5:15 p.m. 24 Mar. 5:05-5:30 p.m.
M	Physics/Math	26 Mar. 8:00-9:10 p.m.
N	Physics/Math	28 Mar. 4:00-5:25 p.m.
X	Physics/Geog.	27 Mar. 4:00-5:00 p.m. 1 Apr. 4:30-5:00 p.m. 3 Apr. 10:00-10:20 a.m.
Y	Physics/Chem.	31 Mar. 4:30-5:40 p.m. 3 Apr. 4:00-4:30 p.m.
Z	Physics/Math	28 Mar. 8:30-9:15 p.m. 2 Apr. 8:00-8:40 p.m.
P	Physics/Math	11 Apr. 3:30-4:30 p.m. 15 Apr. 10:50-11:30 a.m. 19 Apr. 4:30-5:20 p.m.
Q	Physics/Math	18 Apr. 8:00-9:20 p.m. 23 Apr. 4:20-5:10 p.m.
R	Physics/Math	26 Apr. 3:30-4:20 p.m. 28 Apr. 4:30-5:00 p.m.
S	Physics/Math	22 Apr. 8:00-9:30 p.m. 3 May 8:10-9:00 p.m.
T	Physics/Math	25 Apr. 8:10-9:30 p.m. 29 Apr. 8:30-9:00 p.m. 7 May 4:30-5:10 p.m.

APPENDIX D

A WORD-FOR-WORD TRANSCRIPT OF INTERVIEW WITH STUDENT T, APRIL 25, 1985

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Int: Interviewer
St: Student
--- Indicates a brief pause
Emphasized words are underlined

Int: I understand that you are about to finish your diploma program and that you have been studying physics as one of your teaching subjects. I am interested to know about what you think about the physics curriculum?

St: On my part I think the physics curriculum is not really bad---as far as I am concerned. I mean that the content that we cover is somehow valid---yah,---although there are some setbacks.

Int: What do you mean by saying that the content is valid?

St: Yah, valid if you compare the syllabus---because we are supposed to go and teach in the schools---and if you compare the physics syllabus in the schools and what we have been taking here---at least that is what I mean to say it is valid.

Int: Are you saying that the content you have covered compares with the secondary school physics syllabus?

St: No---not in that manner. What I mean is that, what we have been taught here---it is subject matter sufficient and can help you tackle the secondary school syllabus. That's what I mean---yah.

Int: So, you feel that the subject matter that you have covered can help you tackle the secondary school physics syllabus?

St: Yah, that's right.

Int: What do you think about the time and weight given to various aspects of the curriculum?

St: Well, it seems that these days---normally we are interested in passing examinations. This seems to be a trend. And this you can't avoid---so it seems much time and emphasis is put on academic work than methodology. So---a good time is spent on academic rather than methodology. That's according to me---the way I see it.

Int: So you are saying that emphasis is put on academic work?

St: That's right.

Int: What else?

St: Well---and practicals---

Int: What about practicals?

St: Well---in fact, I am very much dissapointed by practicals that the physics curriculum is given---They are very limited---shall we say---not emphasized. That's the problem. But on my side, I prefer practicals---why?---because we are expected to be physics teachers, and if you just concentrate on theory---you will find that some theories are not so easy to explain---I mean, just by mere words; something needs to be done---of course experiments. So, there is a problem of not putting much emphasis on practice---rather we concentrate on theory. That is, I think, is a sort of a setback. That's the way I see it.

Int: Are you saying that practicals are not emphasized but theory is?

St: Yes, exactly. They don't emphasize practical work at all.

Int: When you talk of 'practical work', what exactly do you mean?

St: By practicals I mean---the idea of getting used to doing experiments in all the topics that we are going to teach. And if we understand the experiments then it is better.

Int: What do you mean, to understand the experiments.

St: Well---to understand experiments better, I mean, also to understand how to set the experiments for my students.

Int: Do you find the subject matter easy to understand?

St: The subject---I mean, what we have covered is not tough, it is just fairly easy. Only that some students are complaining that, it seems as if we are doing a lot which we have done in form five and six; but I think as far as I am concerned---I think it is not difficult or not all that easy. It is somewhere there in the middle.

Int: Could you explain further?

St: Yah, I mean that there are some topics which are not very easy. Topics which have been dealt with in secondary school or repeated so many times are not difficult. But there are a few topics which are a bit new, for example, earth physics and electronics which were not dealt with deeply in the secondary schools---here also they are a bit difficult.

Int: Did you say you find earth physics and electronics a bit difficult?

St: Yes, and more so in electronics.

Int: Could you describe the kind of difficulty you experience in electronics?

St: Ah---myself I find it difficult to get the concept. And it is easy to forget---maybe if we could do it practically. For example, the section on transistors ---it is difficult to imagine how it is exactly.

Int: Do you mean if you did it practically then it would not be difficult?

St: I think so, and then the whole thing will be meaningful.

Int: What do you mean?

St: At least when there are practicals---at least you can see the application of it.

Int: What about the relevance of the curriculum. Do you find the curriculum relevant to your preparation for teaching?

St: Yes, I think it is very relevant.

Int: What makes it relevant?

St: For example, you will find that we learn a lot of things like lesson preparation and microteaching which is good---because then we can understand how to present lessons.

Int: What else?

St: I think the teaching practice is also relevant---very relevant to our preparation.

Int: Yes?

St: And then we analyse the secondary school syllabus---and think this should be emphasized more---because this is to make sure that we understand the topics that we are going to teach in the schools.

Int: You have listed lesson preparation, micro-teaching, teaching practice, and syllabus analysis---is that all?

St: I guess so---because then practicals we don't learn much---and these are very relevant also.

Int: What about the instructions? What are your views about the methods of instructions used in the physics curriculum?

St: I think the instructions are good. Our instructor sometimes gets us involved by demonstrating and then discussions, and sometimes experiments---but they are few, but for lectures they are even more.

Int: Is that all?

St: Yes---and lectures are the norm. Those other methods are used once in a while.

Int: Do you find the methods effective?

St: In lectures it is very easy to forget. When somebody comes and gives you a lecture, you will understand at the point when you are talking about it, but after a while you will forget everything. You cannot imagine---because you did not see anything which corresponds or correlates to the knowledge you got and the application.

Int: What about other methods?

St: In fact there were other methods---for example, projects---although not all students did the projects. In fact, there were two or three groups of students who dealt with projects---and you learn a lot.

Int: Did you do a project yourself?

St: Yes, I did a project. It was about a measuring instrument. We (two students working together) were trying to convert a simple d.c. ammeter to be a variable measuring instrument which can also measure voltage and current.

Int: Was this your own idea?

St: No, the first idea was first mentioned by our teacher. He suggested that---that we could make for our projects---a useful instrument that we can take with us and use in the schools.

Int: So, how did you like the project?

St: I think the project method is good. Although our instrument---unfortunately was not completed successfully---but we hope that we can finish it some day---so I think although it takes time---but this method is better than lectures.

Int: What exactly makes it better?

St: Yes, I think it is because we can learn by ourselves and one cannot forget the principles that we use.

Int: Are there any other methods of instructions which were used besides lectures, discussions, experiments and projects?

St: In fact, those are the only methods I was following, but other methods were very scarcly applied in Physics.

Int: Maybe you could now say something about the procedures that are used in assessing students' performance in physics?

St: There is the continuous coursework.

Int: Continuous coursework assessment?

St: Yes, the continuous assessment is not all that bad, it is good. But one bad thing is that this board of national examination seems to concentrate on the results of the final examination. I don't think that it is possible for all two years, attending classes in physics, and doing terminal examinations tests, and what have you, and finally to come out with some bad results. I don't think this is possible-----
So, I think that, perhaps this staff of continuous

assessment is just a cover-up; they don't consider it. Otherwise people could be performing remarkably well.

Int: So you feel that the coursework assessment is not considered in the final grading?

St: Yah---so I am afraid students can fail because the grade is determined by the final exam only--- I don't think it is fair to assess people this way--- because with exams anything can happen---panic--- and what have you. So I think, to try and concentrate on just the final examination it is not a good way of assessment. I know---the problem, perhaps is to do with selection. If they are doing this because they've got some limited places---you see---even if many will pass, some will be reserved---for that matter. But if you are doing this with a good faith, you want to have qualified people who will know what they are doing, then the final examination is nothing.

Int: What else about the exams?

St: It is not the best way to measure achievements. How can---I mean, a three-hour paper be used to decide one's work for two years? This cannot indicate it--- even passing the exam does not mean one has mastered the curriculum.

Int: Are there any other ways in which your performance is assessed?

St: Yes, there is the BTP (Block Teaching Practice) assessment---there is one problem about it. You may be teaching physics, and you are assessed maybe by a tutor who teaches Kiswahili or English, say. Now, there will be some disadvantages---there must be--- because---maybe you may teach well---but he will assess those points which are written there (in the assessment form). Maybe the way you conduct your lesson, your personality---and so on. But something about understanding---about the knowledge of the subject---he himself may not know physics---so if he doesn't know---your explanations may not convince him that you know physics. This problem we do face.

Int: So you are saying that non-physics teachers may not assess a physics lesson appropriately?

St: Yes, and particularly if they are not from the science department.

Int: Any other concerns about the teaching practice assessment?

St: Now, about the assessment itself. Sometimes they don't consider the interval---and sometimes the tutors who come to supervise---they don't take the issue seriously. Some are in a rush—"Haraka Sana" and they don't spend time to discuss the lesson. I think teachers should spend more time in the schools and visit students more frequently.

Int: What about the preparations you had before teaching practice? What is your opinion of it?

St: We were prepared well, because---first we had some methods of teaching, then we were taught how to prepare a lesson, a scheme of work, and also---the microteachings to practice classroom presentations. So, here I think we were well prepared.

Int: Anything else?

St: Again---this problem of experiments. In fact, we had something like five to six experiments---just for the preparation of BTP. And in mathematics we had micro-teaching.

Int: Do you mean you had to do experiments to prepare for your teaching practice?

St: Yes---we did some experiments from the secondary school syllabus.

Int: Did you also set the experiments?

St: Yes, some of them---but the other ones were set by the teacher.

Int: Did you find this exercise useful for your teaching practice?

St: More than useful---yah---I remember my friend using more than two of these experiments in his teaching practice.

Int: What are your views about the situation of facilities and other teaching-learning materials?

St: In our physics lab---there is some equipment, but now time to deal with it is really limited. I don't say that our lab is full of equipment, but for the equipment which are there, if we could have time to use it and get used, it could be a good help

forward---but our time---we are fighting for how we can pass the examinations, so if you waste your time with the equipment, then it will be your funeral. Although others are needed to replace---for example, those which are broken, and other new ones; but those which are there also, we don't have time to use them.

Int: Are you saying that you don't find time to use the few equipment which is there?

St: That's right.

Int: What about books and other reading materials?

St: There are few variety of new books---and we use them all. The library has some old books---with the old units. They are out of date. I think the Ministry should make efforts to improve this situation.

Int: What other suggestions or comments do you have about the physics curriculum?

St: My main suggestion is that, they should do everything---or find a way to make a physics student be in a good position, so that he is not threatened by the examinations like it is now—by reducing the emphasis they put on exams.

Int: What else?

St: And they should emphasize practicals. This is very important.

Int: So you have suggested emphasis on practicals and reduction of the threat of examinations. What else would you suggest?

St: Maybe they could include practicals in the final exam so that everyone will do it---unless it is included---like in the form six for example, practicals are included in the national exams---and therefore the teachers take it seriously.

Int: So you are saying practicals should be included in the final national exam?

St: That's right---because you will find that---in the secondary schools they perform a lot of experiments ---and this because of the exams.

Int: What else would you suggest?

St: Well---no---maybe another time.

A SUMMARY OF INTERPRETATION (VALIDATION)

Student T refers to that which is covered in physics lessons including subject matter covered, the instructional strategies and activities as the physics curriculum.

He finds the curriculum useful in that it can enable him to 'tackle' the work of teaching physics.

The content is fairly easy because much of it is a review of A-level physics. Some difficulty in topics like electronics and earth physics are due to lack of practicals to demonstrate the concepts and to show the application of such concepts.

Finds that there is a lot of emphasis placed on academic work, and that such an emphasis is a weakness on the curriculum.

Sees that much effort is geared toward enabling students pass examinations.

Feels strongly that there isn't enough attention given to practicals and that this will lead to ineffective teaching.

Finds lectures to dominate the instructions although they are not effective in enabling the student understand.

Finds projects and experiments to be very effective and involving the learner, but are rarely used.

Finds continuous coursework assessment to be a good way to measure students' performances but strongly feels that the coursework assessment is not considered in determining students' final grades.

Feels that the national examinations council concentrates on final exam results only, and that this is the reason for students failing in the course.

Perceives the three-hour final exams to be neither reliable nor fair as they encourage cramming.

Finds teaching practice assessment to be a good way of assessing students' competence but feels strongly that supervisions are not conducted well.

Feels strongly that the final national examination is intended for some kind of selection for limited posts and could not be a way to assess students' qualification.

For teaching practice preparation, he found the microteaching and few experiments done very useful.

Suggests more emphasis on practicals and even practical exams.

Suggests less emphasis on examinations.

APPENDIX E

A SUMMARY OF SOME LESSON OBSERVATIONS

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Lesson 1
Date: Feb. 19, 1985 Time: 9:00-10:20 a.m.
Topic: Measurement
Objective: Students to be able to determine errors in experimental calculations.

The lesson was conducted in a lecture format. A few problems were calculated on by the teacher. Students were assigned to solve some problems in class.

Lesson 2
Date: Feb. 28, 1985 Time: 7:45-9:05 a.m.
Topic: A.C. Circuits
Objective: Students to be able to explain and derive Faraday's and Lenz's laws of E.M. Induction

Lecture format. Derivation of the equation $E = -N^{d\phi}/dt$ done by the teacher on the board. Students assigned to read and write their own notes on the application of induction in motors, and transformers. Two classroom textbooks identified to be read for the assignment.

Lesson 3
Date: March 12, 1985 Time: 12:00-1:00 p.m.
Topic: Waves
Objective: Students to be able to explain the occurrence of Doppler effect and its effects.

Mainly lecture format with group discussions in the last 15 minutes. Teacher explanations followed by a derivation of the equations $fo = fs(1 \pm {}^{V}\!/c)$ and $fo = fc(1/[1 \pm {}^{V}\!s/c])$. Students in groups of five discussed the application of doppler effect in measuring of the speed of stars and sattelites.